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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Scrap-Purchase and Police Interference.

A country jobbing foundry has written us to the effect that their local police insist that foundries must not purchase less than 1 cwt. of scrap iron, or 56 lbs. of brass or copper, as a single transaction, and then they can only do so from licensed marine dealers or business firms, to the exclusion of rag-and-bone gatherers or, say, a person who has scrapped an old car, engine or machine which yielded less than the required 56 lbs. of brass. They further insist that the foundry must keep a register specially recording full particulars of all its metal purchases of any description and open to police inspection on demand, and that to enter up in the purchase book in the usual way fails to comply with the law. Our correspondent is under the impression that this law applies only to marine dealers and the like, and not to founders.

It is plain from the Old Metal Dealers Act of 1861 that a dealer in old metals means "*any person dealing in buying and selling old metal, scrap metal, broken metal and partly manufactured goods, whether such person deals in such articles only or together with second-hand goods or marine stores,*" and it is to such persons that the statutory provisions apply, and not to foundry owners. Under the provisions of the Public Health Acts Amendment Act of 1897, every old metal dealer (as defined above) must "*register his name and place of abode and every place of business, warehouse, store and place of deposit occupied or used by him for the purpose of his business in a book to be kept by the Local Authority of the District.*" Further (and this provision applies generally), he must "*correctly enter in a book to be kept by himself for the purpose the description and price of all articles purchased or otherwise acquired by him, and the name, address and occupation of the person from whom the same were purchased or otherwise acquired.*"

It would seem, therefore, that there is no restriction upon the persons from whom certain metals may be bought. The Acts merely prescribe regulations for the conduct of the business of a dealer, and under the Public Health Acts Amendment Act of 1907 any officer or other person authorised in writing by the Local Authority has power of access and inspection under a penalty of obstructing him not exceeding £5.

As to the quantities of metal which may be purchased, the Prevention of Crimes Act, 1871, enacts that it is an offence for any old metal dealer (as defined above) "*to purchase, receive or bargain for lead, brass, tin, pewter, German silver or spelter, or any composite of which any of these metals is the principal ingredient, whether new or old, in quantities less than the quantity specified in the Schedule of the Act.*" These quantities are 112 lbs. in the case of lead and 56 lbs. in the case of the other metals detailed. It will be observed that scrap iron is not mentioned in the Schedule to the Act. The penalty for infringement of the Act is a fine not exceeding £5.

In our submission, a foundry owner is not a "person dealing in buying *and* selling old metal, etc.," and the only onus on him in this connection is the keeping of a special register of his non-ferrous metal purchases (excluding, of course, cast iron), which is open to inspection on a written demand.

Metallurgical Changes.

The appointment of Professor J. H. Andrew to the Chair of Metallurgy at the University of Sheffield will be generally welcomed among founders. The Sheffield Chair is by general consent a post of major importance in the metallurgical world, associated as it is with the work of Arnold and with the eminence of Sheffield as a steel centre. It is, we believe, the only university which has a Faculty of Metallurgy. Professor Andrew has had practical experience in the industry and has held the Chair of Metallurgy at the Royal Technical College, Glasgow. Just as he followed Professor Desch to Glasgow, he now succeeds him at Sheffield. Professor Andrew has naturally done most of his work on steels, but he has also been interested in cast iron, as several Papers on the study of growth in cast iron and the factors influencing it will testify.

It is well known that the vacancy was created by the appointment of Professor Desch to succeed Dr. W. Rosenhain as Superintendent of the Department of Metallurgy and Metallurgical Chemistry at the National Physical Laboratory. Professor Desch cannot begin his duties for a month or so on account of an engagement to lecture in America. The name of Dr. Rosenhain is so completely identified with the Department he created at Teddington that it will be difficult to think of it without him or of him without it. We so often have to admit the superiority of certain foreign countries in research that it should give us special pride to recognise that in the sphere of metallurgical research no institution in the world can equal the N.P.L.

The metallurgical world has welcomed the appointment of Professor Desch, and we hope as founders that he will see to it that the casting and founding aspects of the metallurgical industries receive their due share of attention at Teddington and that the wrought ferrous materials and non-ferrous metals do not absorb the whole of the effort and money expended. The connection of Professor Desch with the Cast Iron Research Association since its foundation leads us to hope for a better balance in future. It is, of course, not proper that research programmes at the N.P.L. should be at the mercy of particular industrial interests, but it should be remembered that all metals, with a few insignificant exceptions, begin their lives in the cast state, and in many cases characteristics formed in this state persist right through the subsequent processes of working. We are aware that this field of work is so difficult that practically no metallurgist would choose to work in it if the choice were left entirely to himself, but that is all the more reason why some of the work of a national institution should be done in this direction.

XUM

The Use of Cast Iron in the Non-Ferrous Industry.*

By A. L. Norbury, D.Sc. (British Cast Iron Research Association).

No apology is necessary for bringing the subject of cast iron before an audience interested in non-ferrous metals, firstly, because, from the metallurgical point of view, there is no dividing line between ferrous and non-ferrous alloys, and, secondly, because cast iron is used for a very large number of different purposes in the non-ferrous industry. It is used, for example, in all works for structural work, in the form of columns and girders and grids, and for the gas and water and steam pipes. It is used for the pots in which metals such as aluminium and zinc are melted and for the firebars and structures of the melting furnaces. It is used for the ingot moulds into which many non-ferrous alloys are cast; for the rolls which roll the ingots into bars and sheets; for the boxes in which the rolled metal is annealed; and for the machinery which fashions the metal into its final form.

Fig. 1.—Typical Microstructure of High-Grade Grey Cast Iron.

Actually cast iron is more widely used than any other alloy. This is so, partly because it is the cheapest alloy, but also on account of its various physical and mechanical properties and the fact that these properties can be varied to a remarkable degree by alterations of chemical composition and by variations in the methods of melting and casting, and by heat-treatment. This variation of properties is possible on account of the complicated nature of the alloy.

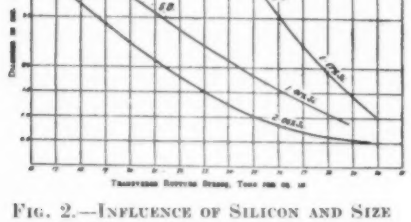

Fig. 2.—Influence of Silicon and Size of Test-Bar on Transverse Strength.

* Paper read before the Swansea Section of the Institute of Metals.

From the metallurgical point of view, cast iron is a most interesting alloy, since it is affected by nearly all the complications that alloys can exhibit. It contains elements in solid solution and elements present in the form of binary, ternary and quaternary eutectics. It undergoes a magnetic and an allotropic transformation on cooling, and shows all the attendant complications that steels do. Its carbon can crystallise out as graphite or as iron carbide and the graphite can crystallise out in the normal or modified form. The properties which are of most importance in connection with its uses in the non-ferrous industry are its general mechanical properties and its heat-resisting properties, and it is with these that it is proposed to deal.

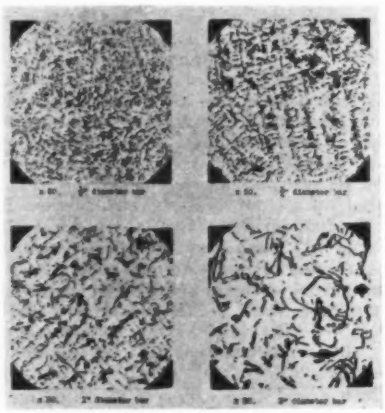

Fig. 3.—Effect of Diameter of Test-Bar on Graphite Size.

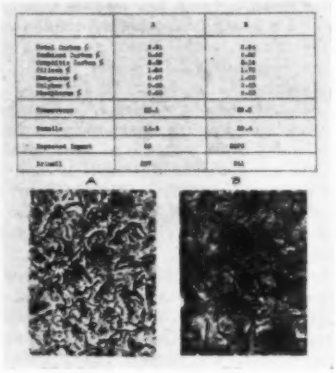

Fig. 4.—Grey Cast Irons of Similar Chemical Composition, but Different Mechanical Properties.

Effects of Chemical Composition and Microstructure on the Mechanical Strength.

A typical microstructure of a high-quality grey cast iron is shown in Fig. 1. The matrix is pearlitic like a 0.9 per cent. carbon steel, and in this matrix have crystallised graphite flakes which have little or no mechanical strength. There may also be present pieces of iron phosphide eutectic which are hard and brittle, and small crystals of manganese sulphide.

In grey irons the percentage of graphite is usually between 2.0 and 3.5 per cent., the combined carbon—in the form of pearlite—between zero and 0.9 per cent., the silicon between 1 and 3.5 per cent., the phosphorus between zero and 2 per cent., the manganese between 0.5 and 2.0 per cent. and the sulphur is usually about 0.1 per cent. The amount of each of these elements present has in each case a definite effect on the mechanical and physical properties, and has to be kept within certain close limits in order to obtain the best properties. The constituent which has the greatest effect on the mechanical strength is the graphite, and the way in which it affects the tensile strength is shown in Table I. Increasing the phosphorus content lowers the strength in a similar manner. Increasing the silicon content also lowers the strength, as shown in Fig. 2.

Table I.—*Influence of Total Carbon on Tensile Strength.*

	Per cent.	Per cent.	Per cent.	Per cent.
Total Carbon ..	2.71	3.08	3.30	3.51
Combined Carbon	0.87	0.79	0.76	0.65
Graphitic Carbon	1.84	2.29	2.54	2.86
Silicon	1.31	1.24	1.21	1.28
Sulphur	0.053	0.080	0.081	0.101
Phosphorus ..	0.41	0.36	0.34	0.34
Manganese ..	1.06	0.94	1.02	0.89
Tensile tons/sq.in.	19.8	17.5	16.8	13.2
Brinell No. ..	235	223	207	207

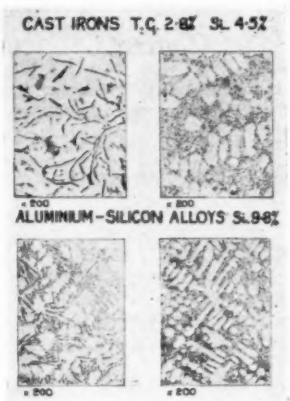

Fig. 5.—Cast-Iron and Aluminium-Silicon Alloys Compared.

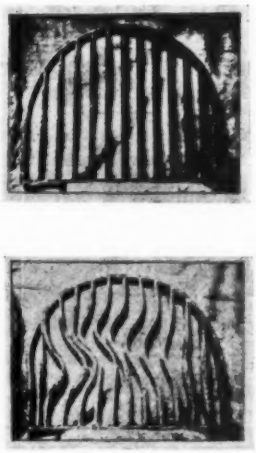

Fig. 6.—Original Pattern of Firebar Casting and (below) Distortion due to Growth after Prolonged Heating.

In this case the transverse strength—which is usually about double the tensile strength—is plotted.

The results in Fig. 2 also show that the strength decreases as the size of test-bar increases. This is due to the size of the graphite structure increasing—as shown in Fig. 3—as the rate of cooling decreases with increase in diameter of test-bar. The strength of grey cast iron consequently decreases as the graphite, phosphorus and silicon contents increase and as

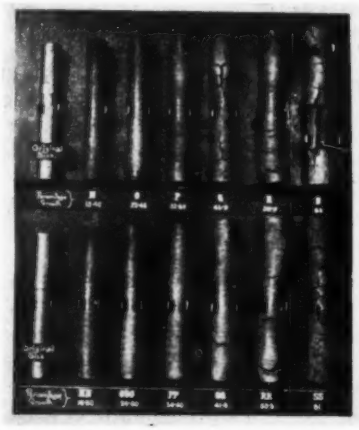

Fig. 7.—Appearance of Alloys after having reached their Ultimate Growth.

the diameter of test-bar increases. There is, however, an additional factor which affects the strength, and that is the way the iron is melted. Two cast irons having widely different mechanical properties, but of the same chemical analysis and cast into the same size of test-bar, are shown in Fig. 4.

The low mechanical properties of the A iron are due to its graphite structure being

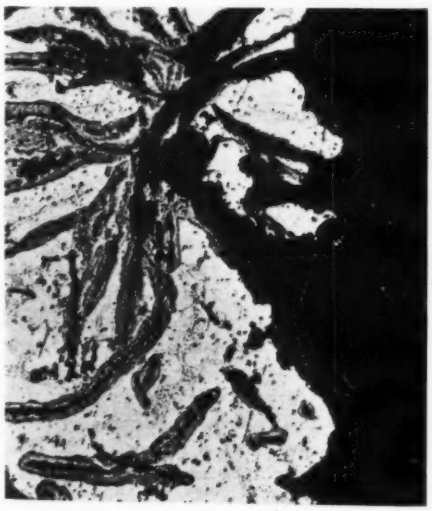

Fig. 8.—Showing Oxidation along Graphite Flakes inducing Growth.

"mixed," that is to say, being composed of both small and large graphite flakes. The relatively uniform graphite structure of B gives it much higher mechanical properties. It is possible to vary the graphite structure in grey irons in the above manner, solely by altering the temperature at which it is melted. The higher the melting temperature or degree of "superheating" the finer the resulting graphite structure. A similar refining of the graphite structure, apart from any alteration in chemical composition, occurs when steel is added to the melt. The phenomenon is believed to be the same as that which occurs when silicon-aluminium alloys are "modified," and the microstructures obtainable are remarkably similar, as shown in Fig. 5.

The precipitation of the graphite or the aluminium silicide, in the finely divided condition, is believed to be due to a super-cooling effect, and in the case of cast iron is due to the absence of

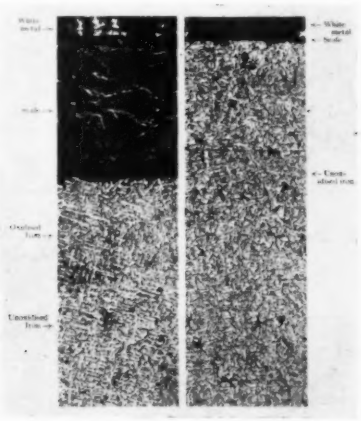

Fig. 9.—Cross-sections of (left) 2 per cent. and (right) 7 per cent. Silicon Grey Cast Iron after heating at 850 deg. C. for 6 days and 8 days respectively, with Limited Access of Air.

graphite "nuclei" in the melt. The theory is that graphite flakes take considerable time to dissolve in the molten metal at ordinary melting temperatures, but dissolve rapidly and completely on superheating. It seems likely that the modification of silicon-aluminium alloys may also depend on the removal of solid particles which act as nuclei, possibly by a slagging action on the part of the modifier added.

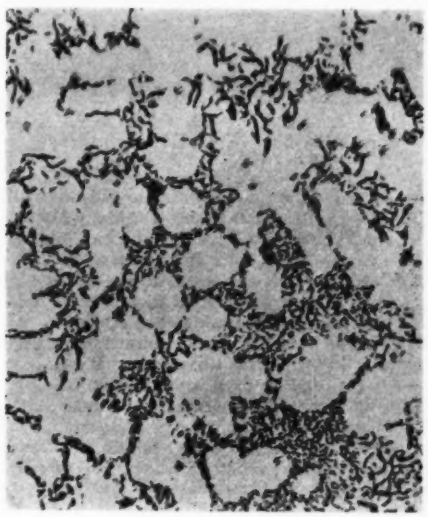

Fig. 10.—Microstructure of "Silal" Heat-Resisting Cast Iron.

In addition to the strength, another very important property of cast iron is its ductility, that is to say, the extent to which it can be bent or deformed without breaking. This ductility is at the best low (being of the order of 1 or 2 per cent. elongation) in comparison with that of steels and decreases progressively as the silicon content increases. Silicon has a similar action in the case of steels where the presence of 4 per cent. silicon is sufficient to reduce the elongation practically to nil. Cast irons containing upwards of 4 per cent. give little or no non-elastic deflection on bending, in other words they are stiff and brittle.

With regard to its heat-resisting properties, grey cast iron has a relatively high melting point (about 1,150 deg. C.) and is consequently comparatively strong even when red hot. Its strength when red hot increases as the silicon

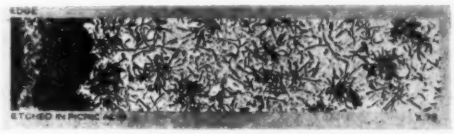

Fig. 11.—Showing Growth of Ordinary Grey Iron Furnace Casting.

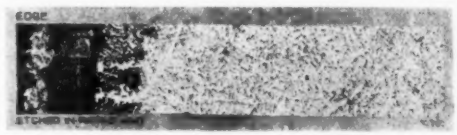

Fig. 12.—"Silal" Casting used for the same duty as Fig. 11.

content increases owing to the stiffening effect of the silicon. Cast iron has, however, an undesirable property when used at high temperatures in that it is liable to grow under such conditions. The way it can grow is shown in Fig. 6, which is from Hurst's text-book on cast iron.

This liability to growth normally increases as the silicon content is increased as shown in Fig. 7.

This shows test-bars used by Rugan and Carpenter after they had been heated 52 times for 4 hours each in a muffle at 900 deg. C. The silicon contents increase from left to right being 1.1 per cent. in N, 1.8 per cent. in O, 2.9 per cent. in P, 4.2 per cent. in Q and 4.8 per cent. in R and 6.1 per cent. in S. These irons had high total-carbon contents and contained coarse graphite flakes. The growth is due to oxidation penetrating down the graphite flakes and causing internal oxidation as shown in Fig. 8 and

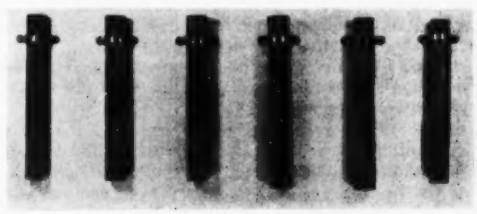

Fig. 13.—Bars Heated for Seven ½-hr. Periods in a Gas Muffle at 1,000 deg. C.

The materials of these bars are, from left to right:—(1) Mild steel; no growth, excessive scaling. (2) Engineering cast iron (1.7 per cent. Si); severe scaling, growth 16 per cent. (3) Cast iron (3.7 per cent. Si); very little scaling, growth 12 per cent. (4) "Silal" cast iron (5.6 per cent. Si); slight surface oxidation, growth 5 per cent. (5) "Silal" cast iron (7.5 per cent. Si); very slight surface oxidation, growth 2.7 per cent. (6) "Silal" cast iron (6 per cent. Si); surface practically untarnished, growth 1.3 per cent.

The increase in growth with increase in silicon is complicated but is chiefly due to the silicon making the metal more brittle and more liable to develop cracks on cooling when it contracts round the wedges of oxidised metal round the graphite flakes. Such cracks provide fresh channels for internal oxidation on the next heating and the process of cracking round the oxidised wedges on cooling is repeated. Since growth is due to oxidation down the graphite flakes it is obvious that the lower the graphite content

the lower the rate of growth, and the smaller the graphite flakes the lower the rate of growth, and this has been proved to be the case.

Apart, however, from its above detrimental embrittling effect, increasing the silicon content has a beneficial effect in so far as it very greatly reduces the rate at which the silicon-ferrite is oxidised. This is shown in Fig. 9.

Tests carried out by the Association showed that this scale-resisting property of high silicon irons gave such irons good growth-resisting properties provided the graphite flakes were in a finely divided condition and not coarse as were those in Rugan and Carpenter's irons, and a patent was taken out for cast irons containing 4 to 10 per cent. silicon and graphite flakes in a finely divided condition. Such irons were given the trade name "Silal." They are made by melting a suitable charge containing steel scrap in the cupola when a cast iron containing about 5 to 6 per cent. silicon is obtained which contains fine graphite flakes owing to the graphite refining action of the steel referred to above. The microstructure of such an iron made in this manner is shown in Fig. 10.

Such an iron gives good resistance to scaling and growth at temperatures up to about 900 deg. C. An illustration of its superiority over ordinary grey iron is shown in Figs. 11 and 12. Such an iron has given good results for firebars and stoker links provided the service conditions are not too severe or so severe that the surface of the metal begins to melt. If this occurs the metal grows badly. If this does not occur its low rate of growth and scaling makes it much better than ordinary grey irons.

The chief defect of this iron is its brittleness, owing to its high silicon content, and it cannot be used for purposes where there is rapid heating or cooling while the iron is below a red heat.

At temperatures above a red heat the iron is ductile and does not crack. On account of this brittleness at temperatures below a black heat it cannot be used for ingot moulds since it cracks—apart from this it would probably behave very well. For the same reason it cannot be used for aluminium and zinc melting pots if they are rapidly heated by means of a fierce oil flame. It is, however, being tried for electrically-heated melting pots. It has also been tried for annealing boxes and under certain conditions has given much better life than ordinary iron and has shown marked resistance to scaling. In order to overcome the above defect of brittleness another high silicon cast iron has been developed which contains sufficient nickel and chromium to make it austenitic. Such irons (known as Nicrosilal) have excellent ductility and do not crack on sudden cooling even with silicon contents as high as 7 per cent., and are equally if not more scale and growth resisting than Silal. A comparative test on such an iron is shown in Fig. 13.

This iron is being tried out for ingot moulds, melting pots and annealing boxes, and up to date the results have been very promising. The iron is readily machinable and can be easily cast. It is unfortunately somewhat costly owing to its nickel content of about 18 per cent., which with nickel at over £200 a ton puts the cost up by about £40 a ton. Even at this price, however, it seems likely that it may be economically used for certain purposes. For example, it may pay to use it for ingot moulds where a very perfect surface on the ingot is required. In many cases its increased life may make it economical. In other cases, however, where the moulds fail through the cutting action or dissolving away of patches of the mould by the molten metal it would doubtless not prove economical.

In order to cheapen the iron, experiments have been carried out to see to what extent the nickel content, required to make it austenitic, can be replaced by manganese and there is every prospect that cheaper irons with almost equally good heat-resisting properties will be developed.

Death of Mr. W. G. Hollinworth.

We briefly recorded last week the death of Mr. W. G. Hollinworth, at one time secretary of the Institute of British Foundrymen. Mr. Hollinworth was born in Glossop in 1856, starting his business career as a clerk with the Manchester, Sheffield & Lincolnshire Railway Company. Later he became identified with Messrs. Ashwell & Nesbit, Limited, ironfounders and heating and ventilating engineers, of Leicester. After a period of business on his own account, Mr. Hollinworth was, in 1920, appointed to the secretaryship of the Institute of British Foundrymen, the Institution of Heating and Ventilating Engineers and British Acetylene Welding Association. Under his guidance the duties of a succession of Presidents, Mr. Matt Riddell, Mr. Oliver Stubbs, Mr. H. L. Reason, Mr. R. O. Patterson and Mr. John Cameron, J.P., were considerably lightened, as Mr. Hollinworth was a most painstaking assistant. During his six years with the Institute he was ably seconded by his daughter, Miss C. Hollinworth, and when, in 1924, he had a stroke which incapacitated him from active business, she carried on his duties until, in 1926, they were taken over by Mr. Tom Makemson. From this stroke he never completely recovered, and in 1927 he retired to a country cottage, "Berea," Oulton, near Lowestoft. We remember with feelings of deep appreciation the help he gave us when we were first appointed as the London Section secretary.

The Late Mr. W. G. Hollinworth.

On behalf of the industry, which he served with such a benevolent efficiency, we offer to Mrs. and Miss Hollinworth our sincerest and deepest sympathy.

Defects in Metal Patterns.—In answer to the inquiry on page 340, Mr. W. E. Warner, Welwyn Garden City, Herts, writes: The pattern plates should first be cleaned with a wire brush so as to clean out all crevices. Next procure some Smooth-On iron cement; this is obtainable in a putty-like consistency and in another grade resembling a thin paste which can be applied as a paint. Fill up any recesses with the putty-like cement so as to make the plate smooth, then allow this to dry and paint the surface with the paint-like material. The materials indicated are obtainable from Walter P. Notcutt, Limited, Southwark Bridge Road, London, S.E.1.

Random Shots.

Dr. MacLean Watts, the honorary chaplain of the Glasgow and West of Scotland Association of Foremen Engineers and Draughtsmen, has been presented with a cap which bears the monogram of the Association, and, on either side of it, the letters H.C. It is a cap that carries privileges. For when Dr. Watts sails to Australia next year, it will save him, when the boat crosses the line, from being stripped, shaved and bathed by Father Neptune's satellites. Another privilege is that he has only to show the cap to be provided with free "lime-juice and sodas." It is, indeed, a cap that I should like to have.

* * *

Two travellers met in Oxford Street, and one asked the other how he found business. "Pretty good," was the casual reply. "I went into Brown's stores early this morning; I spent an hour there and came out with a £1,000 order. Then I went along to Smith's, had a chat with the buyer, and booked £500 worth of orders. I crossed the road to Jones' place and did another £500 of business. And before lunch I just had time to call in at Robinson's new stores and sell another £1,000 of goods. That's not bad, is it?" "No," said the other. "And now what about that money you owe me." "Money I owe you? I don't think I owe you any money." "Well, what about the commission on all those orders. You know very well that if you hadn't met me you wouldn't have got a single one!"

* * *

These are the days of standards and standardisation, yet when a pattern varnish manufacturer wanted the Editor to pass an opinion on his latest product, immediately difficulties were encountered, as there is no such thing as a British standard sand. Actually, the Editor asked a London foundry to place one varnished sample in the sand and allow it to stay there for 30 days; a second one spent its 30 days alternatively in sand and in air. The gain in weight of the samples was positively astounding; but that is beside the question. What one does want is a standard sand, as even in a little experiment such as this there still remain as variables, ramming strength, moisture content, size and shape of sample, elapsed time and nature of the wood used. Here is an interesting, inexpensive piece of research to be done by foundry students of real value to several branches of the industry.

* * *

By the time these lines are read, the Christmas dinner will be but a memory—happy or miserable, depending on as many variables as those tests on pattern varnish. The most important factor is appetite, and following that excellent French custom, "Marksman" wishes all his readers *Bon Appétit*. That the New Year bring in its train, full order-books at profitable prices, busy foundries and no wasters is the sincere wish of

Marksman.

The Institute of British Foundrymen.

LONDON SECTION DINNER.

The Annual Dinner of the London Section of the Institute of British Foundrymen was held at the Holborn Restaurant, London, on Friday, December 11, 1931, Mr. H. C. Dews (Branch-President) in the chair.

The principal guest was Sir Gervais Rentoul, K.C., M.P. (President, British Ironfounders' Association), and other distinguished members and guests present included:—Mr. D. H. Wood (President, Foundry Trades' Equipment and Supplies Association), Mr. W. T. Griffiths, M.Sc. (chairman, London Section, Institute of Metals), Mr. P. Fassotte (a prominent Belgian foundryman), Mr. Nils Gille (of Sweden), Mr. Wesley Lambert, C.B.E., A.K.C., and Mr. V. C. Faulkner (Past-Presidents of the Institute and of the London Branch), Mr. W. Boon (who recently read a Paper to the Branch on "The Use of Pulverised Fuel in Foundry Practice"), Mr. J. Crawford, Mr. W. B. Lake (hon. treasurer to the Institute and Past-President of the Branch), Mr. H. G. Sommerfield (Vice-President and acting hon. secretary of the Branch), Mr. A. W. G. Bagshawe (Vice-President of the Branch), Mr. A. R. Bartlett, Mr. A. F. Gibbs and Mr. H. O. Slater (Past-Branch-Presidents), Mr. Kenneth W. Bridges, Dr. A. B. Everest, Mr. John Shaw, Mr. F. J. Wares, Mr. A. S. Beech, Mr. A. Bartram, Mr. M. J. Cooper, Mr. F. J. Cree, Mr. V. Delport, Mr. G. Lake, Mr. C. H. Kain and Mr. A. C. Turner.

The loyal toast having been honoured,

SIR GERVAIS RENTOUL, K.C., M.P., proposed "The Institute of British Foundrymen, the London Section and the President." Sir Gervais said that on this occasion his feelings—though unfortunately not his features—resembled those of the beautiful bride of Burleigh, of whom Tennyson has said: "A trouble weighed upon her and oppressed her . . . the burden of an honour to which she was not born." He daresay that some of those present might be wondering what on earth did this fellow know about the foundry trade, particularly having regard to the letters after his name—"K.C.," which he was told meant an Associate of King's College, and "M.P.," which was familiar as representing the Metropolitan Police. (Laughter.) He admitted that until some 18 months ago his life had been devoted largely to the serving of law and politics, but since then he had largely abandoned those services and had taken up some really useful work. (Laughter.) It might be asked why the British Ironfounders' Association had wanted such a President. One of his chief qualifications, so far as he was able to gather, was that he knew nothing whatever about the foundry trade; perhaps previous officials of the Association had known a great deal too much. (Laughter.) Naturally, he appreciated the honour, particularly as it had given him the pleasure of being the guest of the London Branch of the I.B.F. on the occasion of its Annual Dinner. The British Ironfounders' Association, he continued, was the employers' organisation in the light-castings industry, which it would be admitted was a not unimportant section of the foundry trade, particularly as it was concerned almost entirely with housing construction, and there was undoubtedly nothing more important and vital to the life of this country to-day than that people should be adequately housed. Although he was a newcomer to the industry, he had already learned sufficient to enable him to appreciate the immense value of a body such as the Institute. From a brochure which the secretary had been kind enough to send him he had learned that the main object of the Institute was to provide means of advancing knowledge of foundry practice and to afford a means of communication between those engaged in the foundry trades. In other words, the Institute existed to assist by education and by technical instruction the material prosperity of the industry, and to promote friendly sociability among its members. The British Ironfounders' Association had very similar objects, although it might approach them from a somewhat different angle.

Importance of Efficiency.

The foundry trades, in common with most other industries, were passing through immensely critical times, probably the most difficult times they had ever faced in the course of their history. If they were to weather the storm, nothing could be more important than that they should increase the efficiency of the industry by adding to the technical skill and knowledge of those who were engaged in it. On the whole, he believed that those engaged in the industry in this country need not fear comparison with any other country in the world so far as the technical equipment was concerned.

We must remember, however, that we lived in a constantly changing age; there was a vital need to adapt ourselves to new circumstances and to changing conditions; in other words, to move with the times. Whilst in the course of his short experience of the light-castings industry he had gained an immense admiration for many of those engaged in it in respect of their general progressiveness and efficiency, it must be admitted, on the other hand—and it was well to face these facts—that some ironfounders were not quite moving with the times to the extent that one would desire to see them move. It would be impertinence on his part to express an opinion on the purely technical side of their business, but he had come across antiquated business methods, a failure to appreciate modern economic conditions and the difficulties which must be overcome if we were to hold our own in the face of the intense world competition of to-day.

In some few instances there had been a refusal to co-operate and work together, and that was regrettable. The main task of the particular branch of the industry with which he was associated in the British Ironfounders' Association was to overcome this backward tendency, to try to create a better understanding between the members, to eradicate that old feeling of suspicion and distrust which seemed to linger still in certain minds. Naturally, as an independent President of the Association, he listened to everything that he was told; he did not say that he accepted everything he was told, and, if he were to accept what was said by some people, he would imagine that all those engaged in the ironfounding industry were a lot of crooks. He did not believe that for a single moment; indeed, he was satisfied that the contrary was the case, although human nature might be just as apparent in the ironfounding industry as in any other. There were men in it who were representative of the best types of Englishmen. A great deal could be done not only by his own Association, but also by the I.B.F., to promote the better understanding which was aimed at and to bring all sections of the industry together. The British Ironfounders' Association could fairly claim to have accomplished a good deal even in a short time. They had been concentrating particularly on an endeavour to promote a better spirit between their own members and those who were engaged in the distributing side of the industry—and it would be admitted that it was equally important to consider both sides and both points of view. As a result, they had arrived at a stage at which there was a good deal of harmony and at which both manufacturers and merchants were ready to exclaim, "The more we are together the happier we shall be."

Sir Gervais paid a tribute to the Institute, and acknowledged the debt which the industry owned to it. We could not create efficiency in a few days or in a few weeks, he continued; it was only by steady, persistent, patient work such as the Institute had been carrying on for so many years that we could hope to attain the goal. There was no short cut, but there was far too much of that spirit about to-day. He had learned enough, in the short time with which he had been connected with the industry, to appreciate the invaluable work of the Institute in improving efficiency, in promoting a better understanding of economic problems—which were almost as important, or perhaps even more important, than technical problems—in promoting a more friendly intercourse between the individual members, which helped them to smooth out their difficulties and to understand each other's points of view. Therefore, it was with the utmost pleasure that he proposed the toast, and coupled with it the name of the President of the London Branch.

The BRANCH-PRESIDENT (Mr. H. C. Dews), responding, said he found it difficult adequately to express his appreciation of the manner in which the toast had been proposed and received. He had looked forward, he continued, with a good deal of pride and pleasure to occupying the position of Branch-President, but since he had had experience of the loyal support which the members had afforded him, his pride in the London Branch had been even further enhanced. He had even wondered what had prompted the members to elect him as their President. Continuing in a more jocular vein, he said that he had never been a President of anything before, and he believed that he had attained the office of President of the London Branch of the I.B.F. only just in time to break his record, because he might be the last "President" of the Branch. He had in mind that one of the committees of the Institute was considering the revision of the rules, and he believed that, as the result of that committee's recommendations, his successors, and perhaps even his immediate successor, would have the less high-sounding title of "Chairman." Perhaps he had also another distinction, for he would not be surprised to learn that he was the youngest to hold the office of Branch-President. He hoped, however, to turn his comparative youth to very good account. In the first place, he would make it an excuse for all his short-comings, which must become only too apparent to the members as the session progressed; secondly, he hoped to turn it to account by rendering long service in the capacity of a Past-President.

Useful Past-Presidents.

This led Mr. Dews to recall the very great debt which the Branch owed to its Past-Presidents. He really believed that they were the life and soul of the Branch; they attended the general meetings and most of the committee meetings, whenever difficulties arose they were ready to help, and altogether they assisted the Branch in a hundred-and-one different ways, in a quiet and unassuming manner, which he had felt was not recognised anything like as much as it ought to be. During the current session there had been one or two very troublesome difficulties, and he really did not know what he should have done without the assistance of several of the Past-Presidents of the Branch. It was, therefore, a very great pleasure indeed to have this opportunity of acknowledging their services, and if he could look forward to giving anything like such assistance himself in the future he would be very happy indeed. Their services were invaluable largely by reason of their experience of the Institute's work. There was nothing like the experience of an office such as this to make one realise what this London Branch meant and what its various functions involved.

The Constitution of the London Section.

When he had assumed office (he continued) he had made some analysis or classification of the membership of the Branch. As a result he had discovered that the foundrymen (those actually engaged in foundry operations, such as foundry foremen, managers and craftsmen) constituted 30 per cent. of the membership; foundry proprietors, directors and managers of works represented 20 per cent.; salesmen representatives of equipment firms, etc., represented another 20 per cent.; metallurgists and chemists, 10 per cent.; research workers, teachers, journalists and so on, another 10 per cent.; the remaining 10 per cent. consisted of foreign members. Therefore the membership included those who held the money and those who were able to spend it; there were the skilled thinkers and the craftsmen, those who could sell the products and those who could tell the world about them. Thus the Branch was in a very favourable position, if it could devise means of combining the activities of all these gentlemen, to achieve something really worth while. There were within the membership many types of minds, and it was by amalgamation of those various types of minds that success could be achieved. He recalled that that great scientist, Sir Oliver Lodge, in his May Lecture to the Institute of Metals a few years ago, had spoken of several types of minds and had mentioned one which he had characterised as the type of mind which made a bald-headed rush, or, to use more polite language, which created the spirit of unorthodox enterprise. Mr. Dews said he felt that there were a few such men in the London Branch of the Institute, and he suggested that they could be given a little rope now and again. There were also those who remembered Shakespeare's words against vaulting ambition "which o'erleaps itself and falls on t'other side." Those men would put the brake on if the attempt were made to go too fast. Between these two extremes there were many types of mind and shades of opinion which served to leaven the whole.

If all these various types of mind co-operated together he felt they would ask themselves a lot of questions. For example, they would ask themselves if in their activities they relied too much on conventional ideas, whether they were taking sufficient account of changing conditions, and whether their affairs were being conducted in a modern and business-like manner. They would wonder whether they were adhering too much to tradition and to the prejudice which was born of tradition. To all those questions they would find it difficult to answer; indeed, to some of them there might not be an answer, but he urged the members to bear these and similar questions in mind, and if there were any answers to these questions he felt sure that the Branch would benefit by finding them. Some would, perhaps, remember a very-much-advertised system of mind and memory training which was boomed particularly during the war. At that time he also had had an ambition to become "a brigadier-general in six weeks," and he had a recollection of having paid a few guineas for the privilege of receiving a judiciously regulated stream of little grey books. Whether the form of advertising was of more moment than the memory training, or whether his mind was more receptive to the former than to the latter, he did not know, but he did know that he had forgotten all about that memory training with the exception of one item; it was that that system had insisted very frequently on a process of self-analysis. He had often felt that such a process could be applied to an organisation such as the London Branch of the Institute. He felt that the members should ask themselves, not once or twice, but continually, what they were doing, where they were going and what they were getting at. Each member should ask himself what he wanted from the Institute and what use was it to him. But there was another side to the picture, and he emphasised that none of them could get anything out of such an organisation until all of them had put something into it. Therefore, they must ask themselves what they could give to the Institute which would be of service to its membership as a whole. If these two types of questions were answered properly they would have a clue to the aims and objects of the Institute. If they answered these questions they would find that the word "knowledge" cropped up very frequently. They would probably say that the function of the Institute was to disseminate or exchange knowledge. He urged, however, that that was not enough, and that they must define that knowledge and say exactly how they were to set about exchanging knowledge. Classical education taught us to gain knowledge for its own sake and placed a great deal of reliance on knowledge as such. Business training, business opportunism, on the other hand, taught us what he would regard as the exact opposite; it taught the spirit of application and placed very little faith in mere knowledge. Those who were supporting technical industry, however, must concern themselves not only with knowledge but with its application; to them one was useless without the other. They did not want brains without substance and they did not want to be mere machines. Between these two, which could be called science and practice, there was the great characteristic called experience, and he felt that it was by facilitating the exchange of experience that the Institute would find its true function; it was in that direction that the Branch could render the greatest possible service. He urged all members to think about this exchange of experience and to see to it that the Institute of British Foundrymen continued to flourish in the future as it had done in the past.

The Guests.

Mr. Wesley Lambert, C.B.E., A.K.C. (Past-President of the Institute and of the London Branch), proposed the toast of "The Guests," though he modestly questioned his ability to do it justice, and in this connection recalled a saying accredited to an old Persian philosopher, to the effect that if we could but think on the occasion what we could when the occasion had passed, what wits we should be! However, he felt it a great honour to be asked to propose the toast, more particularly as he had to couple with it the name of Mr. D. H. Wood. He recalled that a few days previously he had read in a daily paper that Mr. Priestley, the author of "Good Companions" and one or two other books, had threatened to quit any banquet at which he was one of the guests if the proposer of the toast to the guests had referred to him by name as a good companion. Be that as it may, said Mr. Lambert, he would refer to Mr. Wood as a good companion, as would be appreciated by all who had had the privilege of meeting him on this and other occasions. Indeed, all the guests present had proved themselves to be good companions. The London Branch of the Institute of British Foundrymen was very proud of the position it occupied in relation to the parent Institution, and its members were always very gratified and delighted to have present at its Annual Dinner so many distinguished guests. Mr. Lambert, in welcoming Mr. Wood and Sir Gervais Rentoul particularly, was amusingly reminiscent, though his remarks perhaps were not wholly reportable. Other distinguished guests whom he mentioned particularly by name were Mr. Nils Gille, Mr. Fassotte, Mr. W. T. Griffiths (Chairman of the London Section of the Institute of Metals), Mr. K. W. Bridges (of the Foundry Trades' Equipment and Supplies Association), Mr. W. Boon (to whom the Branch was indebted for having presented a Paper during the present session) and Mr. Mann, a representative of the "New York Herald." He coupled with the toast the name of Mr. Wood.

Mr. D. H. Wood (President of the Foundry Trades' Equipment and Supplies Association), responding, expressed thanks on behalf of the guests for the hospitality extended to them and for the kindly references which had been made to them. Having been a guest on previous occasions he could assure the Branch that he looked forward to this particular function as being a very enjoyable one.

Mr. Wood was in some difficulty and caused some amusement to the company—who were also sympathetic—when he described how his suit case had been despatched by the hotel staff with the luggage of the previous occupier of his room, the suit case having contained not only his dress suit but also the notes of the speech he had intended to make. In a comment on Sir Gervais Rentoul's remarks, however, concerning the necessity for some founders to re-model their equipment, he pointed out that the Equipment Association was entirely at the disposal of the foundry industry and was particularly anxious to help them and advise them concerning installation of the right equipment which would enable them to achieve the best results. He attended the Dinner, he concluded, as President of the Equipment Association, knowing that a reliable equipment firm would never let the foundrymen down.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Customs of the Trade.

To the Editor of The Foundry Trade Journal.

Sir,—My attention has been drawn to your leading article in your issue of December 10, on the subject of insurance of patterns. As you say, the question must be governed by local considerations, and we should be very glad to see an expression of opinion by a lawyer, made after a study of the outside cases.

So far as the custom of the trade goes, however, we would say that in this district it is the practice of the founder to leave the responsibility of insurance to the owner of the patterns, this practice being expressed in the following paragraph taken from the "Standard Conditions of Sale" drawn up by this Association:—

"*Patterns.—Every reasonable care and precaution will be taken of customers' patterns while on members' premises, but we cannot accept any responsibility for damage by fire, lengthy storage, reasonable wear and tear, etc.*"

Yours, etc.,
Percy Russell, Secretary,
Leicester and District Ironfounders
Employers' Association.
8, New Street, Leicester.
December 12, 1931.

Iron and Steel Output in November.

The National Federation of Iron and Steel Manufacturers report that the blast furnaces in operation at the end of November numbered 70, compared with 66 at the end of October and 92 at the end of November, 1930. The production of pig-iron amounted to 296,400 tons, compared with 284,200 tons last October and 384,100 tons in November, 1930. The production included 68,000 tons of hematite, 123,500 tons of basic, 89,300 tons of foundry and 11,000 tons of forge iron. The November output of steel ingots and castings amounted to 459,200 tons, compared with 457,400 tons last October and 433,800 tons

Aluminium can be tin-plated in a bath composed of 12 oz. sodium stannate, 2 oz. sodium acetate, 2 oz. caustic soda and 1 gallon water.

The Steel Foundry of F. H. Lloyd & Company, Limited.

This steel-foundry business was established in 1879 at Wednesbury, Staffs, and became a limited liability company in 1888. The works occupy an excellent site adjacent to the London Midland and Scottish Railway, Birmingham to Wolverhampton line. Raw material enters the works on extensive sidings, where the level makes a cheap and excellent substitute for a pit. Again, it will be noted that the pattern storage is not confined to any one building, as the firm, having ample ground available, has minimised serious fire risk by decentralised buildings.

In a jobbing foundry business, be it iron or steel, elasticity is an essential feature, and this has been well taken care of at Wednesbury by the provision of both light- and heavy-castings shops.

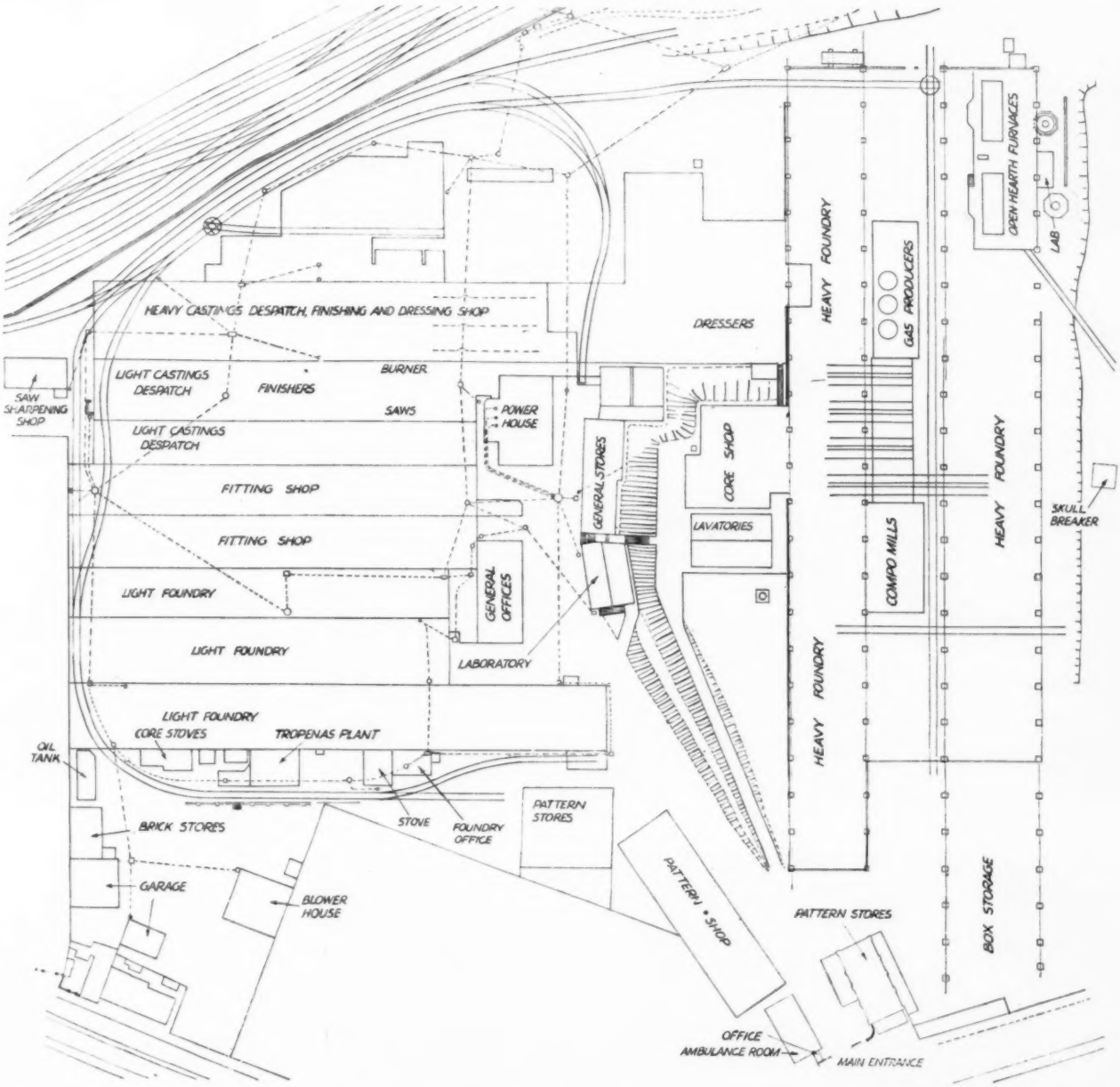

FIG. 1.—GENERAL LAY-OUT OF THE FOUNDRIES OF MESSRS. F. H. LLOYD & COMPANY, LIMITED. THE DRESSING SHOP IS AT A LOWER LEVEL THAN THE HEAVY FOUNDRY, THE DIFFERENCE OFTEN BEING UTILISED AS A PIT FOR CASTING VERY DEEP JOBS.

pig-iron and scrap is handled by a 25-ton Royce crane fitted with an Allen West magnet.

The general arrangement of the works is shown in Fig. 1. There are several factors in this connection which are of outstanding importance. Primarily, the levels of the works have been usefully utilised in connection with the heavy foundry and the fettling shop. Castings are taken by overhead crane and lowered into the cleaning department, and if a very deep mould has to be cast this difference in automatic producers. The charging side of the furnaces is shown in Fig. 2. For handling the liquid metal, moulding boxes, moulds and cores, eight overhead cranes, all of 20 tons lifting capacity, span this bay. Should trade conditions warrant, there is a standby plant of a pair of 1½-ton Tropenas converters. As this plant is duplicated in the light foundry, it will be dealt with under that head.

For moulding, both dry sand and loam are used, and for the preparation of the former sand mills of a heavy roller type of their own design are used. Drying is effected in a battery of August stoves, the temperature of which is controlled at 350 deg. C., though obviously this is varied somewhat, according to the nature of the sand and the size of the mould. Cores are also being dried in a battery of August furnaces, which, at the time of our visit, was under construction. Moulding is carried out either by hand, using either "Thor" or "Consolidated" pneumatic rammers, or by a portable-type Sandslinger.

The Heavy Foundry.

Melting is carried out in two stationary Siemens open-hearth basic furnaces of 20 tons capacity. The furnaces are hand-charged, and gas is provided by three—one a spare—Morgan

FIG. 2.—THE MELTING SHOP, SHOWING THE TWO 20-TON OPEN-HEARTH FURNACES.

FIG. 4.—THE PATTERN SHOP. MESS[illegible] F. [illegible]

FIG. 6.—EMPLOYEES' RECREATION GROUND AND CANTEEN.

FIG. 7.—AN AERIAL VIEW OF THE WORKS OF [illegible]ESS[illegible]

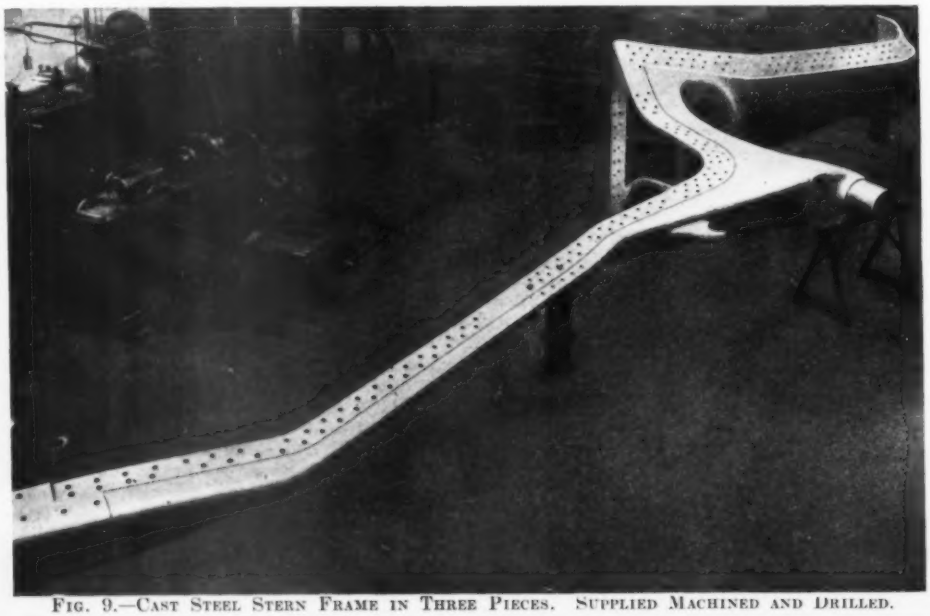

FIG. 9.—CAST STEEL STERN FRAME IN THREE PIECES. SUPPLIED MACHINED AND DRILLED.

FIG. 10.—A 20-TON BEDPLATE, FOR THE WE[illegible] S[illegible]

Messrs. F. H. Lloyd & Company, Limited.

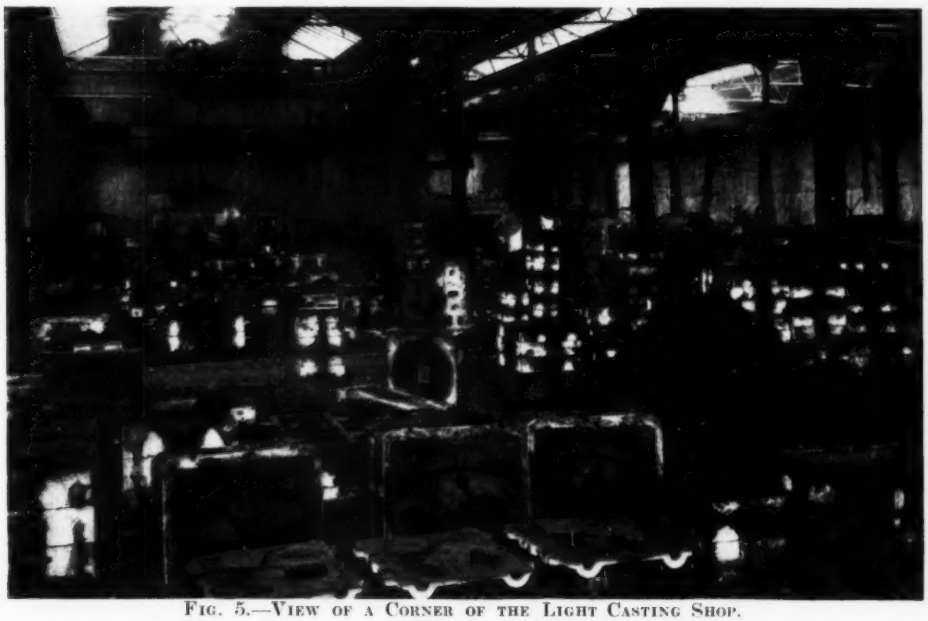

Fig. 5.—View of a Corner of the Light Casting Shop.

Works of Messrs. F. H. Lloyd & Company, Limited.

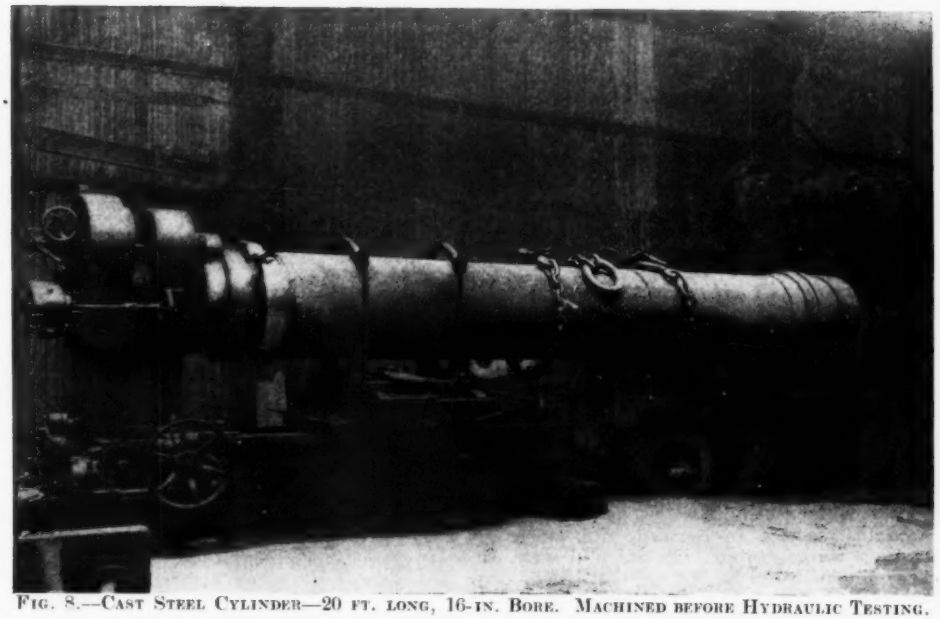

Fig. 8.—Cast Steel Cylinder—20 ft. long, 16-in. Bore. Machined before Hydraulic Testing.

the Wellman Smith Owen Engineering Corporation.

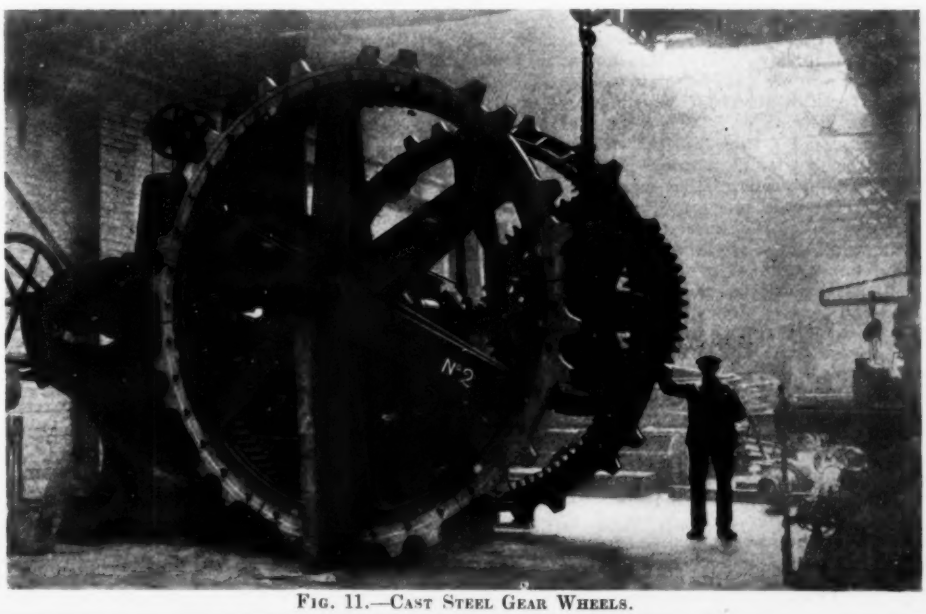

Fig. 11.—Cast Steel Gear Wheels.

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Materials Control.

The skin obtained on these large castings is excellent, and the firm attach so much importance to it that they have established a special laboratory devoted to both routine and research work on foundry sands. It utilises to a large degree the standards originated by the American Foundrymen's Association, and covers the testing for permeability, grain size, bond and sintering temperature. A good deal of work has been done on the incorporation of Bentonite into British sands with some interesting results.

Modern chemical, physical and microscopical laboratories supplement the work of the sand laboratory by controlling the composition of all purchased material, manufacturing processes and deliveries.

The Light Foundry.

As already stated, the Tropenas process is used for the provision of liquid steel. There are two vessels of 1½-ton capacity, and a heat is blown down every 15 min. The cupolas have a capacity of 10 to 12 tons an hour. They are lined to 54 in. with Silacene. For the converters, Cupoline is used, and a life of 40 to 50 heats is obtained. The metal before entering the converter is treated with soda ash, placed in the bottom of the heated ladle. This system allows more latitude in the choice of raw materials, whilst ensuring that the final result will be satisfactory. In common with other steel-castings manufacturers, the technical staff attached to this concern believe that whilst sulphur reduction is effected, other beneficial properties are bestowed on the metal.

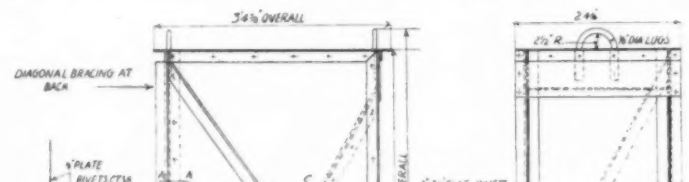


Fig. 3.—Design of Bin used for Transporting Sand at the Works of Messrs. F. H. Lloyd & Company, Limited.

Sand Preparation.

Whilst both green and dry sand castings are made in the light foundry, the former was predominant at the time of our visit. The sand used for this purpose consists of 40 per cent. of new Belgian and 60 per cent. of floor sand. Large quantities of the former are ordered in the autumn, in order to prevent it being subjected to bad weather conditions. It is unloaded into the storage bins direct from the wagons. From the bins it is fed directly into the bucket of a self-loading August-Simpson intensified mixer mill. The old sand is elevated to the uppermost of the two Hum-mer screens arranged one above the other. The first screen removes all gaggers, hard cores, nails and the like. The lower screen separates the dust and retains the usable sand, which is directed by a shute into the bucket loader of the Simpson mill. About 90 per cent. of the sand is thus reclaimed. The mill discharges into special bins, a sketch of which is given in Fig. 3. The bins of prepared sand are distributed to the moulders by Morris overhead runways. The material for dry sand castings, which may be either composition or sand, is milled in the usual type of edge runner mill. Adequate transport is provided in this foundry by the provision of four 5-ton cranes. Amongst the moulding machines used are three of the International type.

Core Making.

For the making of cores, oil sand is largely used, and both jar-ramming (for the larger cores) and hand-jarring machines fitted with vibrators for the smaller cores are used. The cores are dried in Mond gas-fired stoves, carrying shelves and racks, and controlled at 230 deg. C. The castings are transported in Hudson wagons, running on a 24-in. gauge railway to the fettling shop, which is common to both heavy and light foundries.

Cleaning Department.

Runners and risers are cut off either with cold saws or, perhaps more generally, with the oxy-acetylene. In this connection it is interesting to note that the firm manufactures its own acetylene and liquid oxygen, plant supplied by Messrs. Metal Industries, Limited. Here provision is made for either bottling or distribution by piping to various points in the fettling shop. The acetylene also is piped to the points of consumption. The sand-blast plant consists of four rooms, 6 ft. 6 in. square, operating on the well-known Tilghman system. In addition there is a Tum-blast sand barrel. This apparatus is the first we have seen working outside a foundry exhibition. It is made by the American Foundry Equipment Company. Castings are charged on to an inclined travelling grate, the movement of which imitates the action of an ordinary tumbling barrel, but in this case they are subjected to a stream of shot under high pressure. Moreover, reversing the movement of the grate causes the automatic evacuation of the machine.

Excellent facilities are provided for straightening castings which may become warped during solidification. These include a 50-ton power press driven through a friction clutch manufactured by the Lucas Machine Tool Company of U.S.A.

For larger castings a simple hydraulic press is used which has been designed by the firm to meet many varied requirements. All castings are submitted to heat-treatment in Mond gas-fired furnaces controlled by recording pyrometers manufactured by the Cambridge Scientific Instrument Company. Besides the ordinary tensile tests, microscopic examination is carried out. The largest annealing furnace will hold a casting 22 ft. square, and there are other smaller furnaces available down to 8 ft. square.

Pattern Shop.

This firm is fortunate in possessing a particularly fine pattern shop. It is well lit and ventilated, and covers an area of 150 × 50 ft. Wadkins, of Leicester, have been made responsible for the provision of most of the machinery, which includes an automatic wood miller, a 16-in. dimension saw, a circular saw bench, dice and vertical 30-in. sanders, several planers, band saws, lathes, plane and moulding iron grinding machine, a 10-in. double-ended bench grinder, and a number of smaller tools. The shop is illustrated in Fig. 4.

Welfare.

Few foundries have done more to establish good relationship with their employees than this company. The welfare committee is an active organisation, dealing with matters of health of the employed and working conditions.

Associated with the firm are football, cricket, bowls, angling, billiards, and even cribbage teams. The works canteen is well patronised, and is regarded by the employees as their own club.

Some years ago a superannuation scheme was created, into which the firm has paid 10 per cent. of the dividend, whilst the employees have contributed 6d. in the £ of their wages. The assets have reached a total of £15,000, and are invested in Trustee Stocks.

Conclusion.

Unquestionably the steel foundry at Wednesbury represents all that is best in British steel foundry practice. There is little scope in England for American quantity production methods, as repetition orders are few and far between, but by dividing the business into light and heavy sections, by ensuring reasonably good transport facilities, by providing excellent pattern and machine shops, by instituting rigid control over raw materials and processes, Messrs. F. H. Lloyd & Company, Limited, certainly can offer facilities of an extremely high order to buyers of small steel castings, whilst the provisions they have for handling the heavy variety is well recognised in British industry. Finally, we wish to express our indebtedness to Mr. F. J. Hemming, managing director, and his staff for the help accorded to us in the preparation of this article.

Imperial Co-operation.

The Empire Committee of the Federation of British Industries has been re-constituted under the chairmanship of Sir Arthur Duckham, G.B.E., K.C.B., President-elect of the Federation.

Amongst the more prominent members of the Committee are:—Rt. Hon. Lord Barnby, C.M.G., C.B.E., M.V.O. (Past-President of the F.B.I.); Sir Hugo Hirst, Bart (chairman, General Electric Company, Limited); Sir Alexander Walker (chairman, John Walker & Sons, Limited); Major Sir E. Humphrey M. Leggett, D.S.O. (chairman, British East Africa Corporation, Limited); Mr. Frank A. Beane (chief general manager, Lloyd s Bank Limited); Mr. Charles Mitchell (chairman, Dorman Long & Company, Limited); Mr. Julian Piggott (British Steel Export Association); Col. F. Garrett (Agricultural & General Engineers, Limited); Major C. J. Kavanagh (British Steel Works Association); Mr. James A. Main (A. & J. Main & Company, Limited); Mr. Joseph Maudslay (Agricultural & General Engineers, Limited); Sir Gervais Rentoul, K.C., M.P. (British Ironfounders Association); and Mr. T. H. Thatcher (Atlas Preservative Company, Limited).

The terms of reference of the Committee are:—(1) To carry out a continuing study of Empire Trade problems, and to encourage joint action on the part of industries with regard to Empire Trade; (2) To prepare for the next Imperial Conference, and (3) To examine how far co-ordination can be secured in the Empire Trade activities of this country.

Welding Qualities of Steel.*

By Wilmer E. Stine.†

It has been recognised for some time that all steel having the same commercial analysis is not equally good as welding wire or electrode material. Some investigators have found that good electric-arc-welding wire shows a certain type of segregation. It seems that one could justly raise the question as to whether this segregation is an essential factor in good electrode material or whether it occurs under the condition which produces good steel for welding wire.

Since, in arc welding, the metal of the plates or parts being welded enters into the composition of the metal forming the seam, a complete study of the elements which affect the results in arc welding should include a study of steel used in the manufacture of plates and shapes as well as the electrode material. Electric-arc welding will be considered herein as that method of fusion welding in which the seam to be welded is filled with molten metal melted by the heat of an electric arc and allowed to solidify, thus forming the weld.

Various Types of Electric-Arc Welding.

Electric-arc welding may be divided into three classes as follows: (*a*) Metallic-arc welding with bare or washed electrodes; (*b*) metallic-arc welding with shielded arc electrodes (electrodes with a heavy coating to protect the arc from the oxygen and nitrogen of the atmosphere); (*c*) carbon-arc welding with a shielded arc.

In the first two methods the weld is composed of metal from two sources, viz., metal from the electrode and metal from the plates or material being welded. Consequently the resulting weld is affected by the parent plate, the electrode material and its coating. In the third method, the welds can be satisfactorily made without the addition of filler material, and the weld metal is composed of metal from only one source, viz., the plates being welded. Therefore, carbon-arc welding with a shielded arc seems to offer the best method of welding for a study of the factors that affect the welding characteristics of steel. Defects that may develop because of certain characteristics of the steel forming the weld are as follows: (*a*) Cracks; (*b*) slag holes; (*c*) gas holes. Causes of the first class of defect seem to be fairly well understood. This investigation is largely confined to the causes of the latter two classes of defects.

Gas holes are not formed to any appreciable extent where the arc is in an oxidising atmosphere. The weld metal in such cases is over-oxidised and has very little ductility and will not be a high-quality weld. High-quality arc welds can only be made with a shielded arc. Gas holes become an important factor in such welds.

The first series of samples used in the investigation was made by taking very low-carbon, low-manganese steel and melting it in an electric furnace, adding various desired amounts of carbon and manganese. This steel was then rolled into plates and welded. All samples in this group proved to be poor welding quality. Subsequent tests and analysis indicated that the steel used as a basis for this series of samples had been deoxidised with an excess amount of aluminium and that the aluminium was the principal controlling factor. The determination of small quantities of aluminium in steel is very difficult and the accuracy very problematical and is therefore not considered reliable. Analysis of the basic steel in the above series showed 0.018 per cent. aluminium. A second series of samples was obtained from various steel mills, and consisted of fire box, flange and tank steel having a carbon range of from 0.12 per cent. to 0.20 per cent. Each steel-maker was asked to furnish information as to kind of furnace used, whether the steel was recarbonised, how it was deoxidised, and whether it was killed or rimmed. A third series of samples of various carbon content was obtained from one steel maker and consisted of steel varying in specifications from SAE 1010 to SAE 1050 inclusive. A fourth group of samples was obtained from two steel makers and consisted of samples from several heats of representative commercial grades of steel.

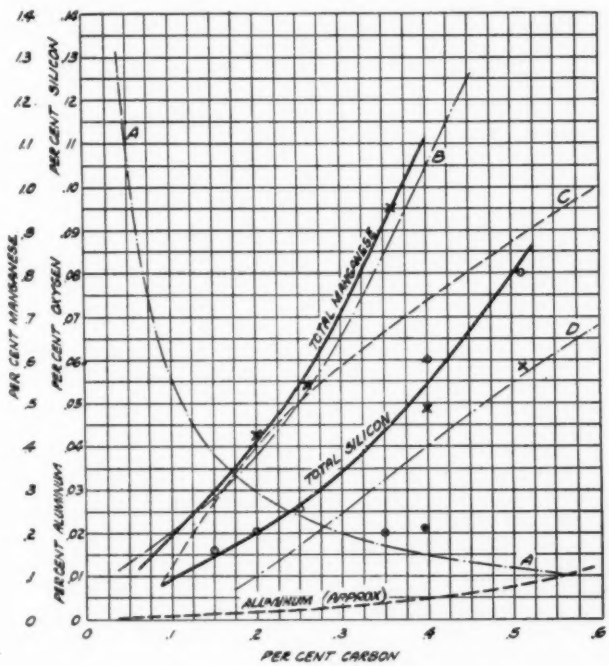


FIG. 1.—CURVES INDICATING ALUMINIUM, SILICON AND MANGANESE CONTENT OF STEEL OF OPTIMUM ARC-WELDING CHARACTERISTICS AS DETERMINED BY WELDING TESTS.

Curve A—Carbon-oxygen equilibrium curve at 1595 deg. C. from Herty and others. Curve B—Manganese-oxygen equilibrium curve from Oberhoffer and Schenk. Curve C—Total silicon-oxygen equilibrium curve from data by Herty and Fitterer. Curve D—Free silicon-oxygen equilibrium curve from Herty and Fitterer.

It was found that steel which formed slag holes in the weld invariably had been aluminium killed and contained an appreciable amount of Al_2O_3. The sample shown contained 0.03 per cent. Al_2O_3. This characteristic was checked by covering a piece of good welding steel with a thin layer of Al_2O_3 before welding it. In order to determine whether this characteristic is a matter of melting temperature of the inclusions, a similar test was made with chromite, which has about the same melting temperature (2,050 deg. C.) as Al_2O_3. The result was almost identical. It is somewhat apparent that the behaviour of the metal when being melted under the electric arc during the arc-welding process is different than when it is melted in the furnace preparatory to being made into castings. It is believed that this difference is because of the higher temperature and the relatively greater area exposed during arc welding.

In steel-making or casting, the temperature does not greatly exceed 1,600 deg. C. In arc welding, the temperature of some of the metal is raised to its boiling point, which is probably around 2,500 deg. C. It is evident that these slag holes or depressions are caused by non-metallic inclusions in the steel, which remained as finely-divided solid inclusions during the steel-making process, but during the arc-welding process melted and coalesced to form large globules which solidified ahead of the steel and formed holes or pits in the weld metal. These holes can be eliminated by using a slag-forming flux of low melting temperature which will combine with the slag of the steel forming a new slag having its melting temperature below that of the steel.

Formation of Blow Holes.

Steel may hold certain gases such as hydrogen and nitrogen in solution at room temperature. Carbon monoxide and carbon dioxide may be produced in steel at elevated temperatures as a result of chemical reaction between the carbon of the steel and oxygen in the form of oxides contained in the steel. Gases may be absorbed from the surrounding atmosphere by the molten metal while it is being welded.

It is a well-established fact that the capacity of liquid steel for holding gases in solution is much greater than that of solid steel. The gases held in solution by the solid steel would not cause the formation of gas holes when being welded, if the further absorption of gases by the liquid steel and the formation of gases by chemical reaction could be prevented without decreasing the capacity of the steel to hold gases in solution. It has been fairly well established that the capacity of steel for holding gases in solution varies directly with temperature and the content of aluminium, silicon and manganese and inverse with the carbon content.

If the capacity of the steel for holding gases in solution is to be maintained at a value equal to what it was in the ingot moulds, the aluminium, silicon or manganese must not be oxidised out during welding to any appreciable

* From a Paper read before the American Iron and Steel Institute at New York.

† Research Engineer, the Lincoln Electric Company, Cleveland, Ohio.

extent. In order to prevent the rapid absorption of gases at the high welding temperatures the content of aluminium, silicon and manganese should be as low as practicable. The oxidation of carbon during welding is permissible, but this reaction should cease before solidification of the weld metal begins.

In other words, chemical equilibrium should be reached between the carbon and the oxygen in the steel at a temperature slightly above the temperature of solidification, and at least one deoxidising element (aluminium, silicon or manganese) should be present in an amount which will also be in approximate chemical equilibrium with the oxygen present in the steel at a temperature slightly above the temperature of solidification. Under this ideal condition a steel of given carbon content will have a minimum capacity for absorbing gases at the high welding temperature. Its capacity will increase as the carbon is oxidised. The formation of carbon monoxide will cease before the metal solidifies and there will be a minimum change in the amount of gas-solvent elements such as manganese, silicon or aluminium. Such steel should therefore have the best arc-welding characteristics.

The results of the tests seem to verify the theory set forth above. An excess of aluminium, silicon or manganese is capable of causing gas holes in the weld metal. It was also found that the weld metal in dead, soft steel may be porous, due to gas holes, unless a slag-forming flux is used to cover the weld metal while it is molten.

In order to determine what manganese, silicon and aluminium content in steel imparted to the steel the best welding characteristics, the analysis of the steels that produced welds practically free from porosity were plotted against the carbon content, as shown in Fig. 1. The curve for aluminium was not plotted from actual analytical data taken during these tests. Analyses for aluminium were made on several samples used in these tests in accordance with the Bureau of Standards method. This method is admittedly not accurate to more than plus or minus 0.01 per cent. No satisfactory welds were obtained on any aluminium-killed steel which showed by analyses more than 0.018 per cent. total aluminium.

It was found by Brinell that an addition of a given amount of aluminium to steel was as effective in preventing the formation of gas holes in steel castings as about 10 times that amount of silicon. In view of the above and the difficulty of an accurate determination of aluminium in steel, the curve for aluminium was plotted as being equal to 10 per cent. of the values of silicon shown in Fig. 1. It is evident that the proper control of aluminium in steel plates, sheets, filler rods, or electrodes for welding should be left to the steel maker. The inaccuracy of an analytical determination of aluminium makes it impractical to include limits for aluminium in steel specifications. However, the deleterious effect of a slight excess of aluminium is so great that it must be carefully controlled in the manufacture of steel for electric-arc welding.

The values indicated in Fig. 1 for manganese and silicon are considered to be ideal values. Permissible tolerances have not been accurately determined. The data would seem to indicate that the following tolerances (per cent.) could be permissible: Manganese, plus or minus, 0.10; silicon, plus or minus, 0.015; aluminium, plus or minus, 0.01. The oxygen curve in Fig. 1 is taken from the carbon oxygen equilibrium curve at 1,595 deg. C. by Herty and others. By the use of this oxygen curve the curves for silicon and manganese were checked against the manganese-oxygen equilibrium curve by Oberhoffer and Schenk and the silicon-oxygen equilibrium curve by Herty and Fitterer.

The close conformity of these curves with the individual equilibrium curves established by the various investigators indicate that the equilibrium theory furnishes a correct basis for the manufacturers of steel of good electric-arc welding quality. It has been determined during this investigation that in most cases satisfactory welds can be obtained in welding steel plates which were not in themselves of good welding quality steel by the use of the proper fluxing material, filling or electrode material. Best results can only be obtained when the steel to be welded is of good electric-arc welding quality.

Other things being equal, the tendency for gas holes to form increases with the speed of welding. As arc-welding speeds are being stepped up the importance of the proper quality of arc welding steel for plates, filler rods and electrode material becomes increasingly important.

Conclusions.

Aluminium oxides or any other non-metallic inclusion in steel which has its melting point between the melting point and boiling point of steel will cause slag holes, or pits, in the weld metal of electric-arc-welded steel unless it is fluxed with some other material which lowers the freezing point below that of the steel.

Aluminium, silicon, manganese or any other deoxidisers having gas-solvent properties which are present in excess of the quantity necessary for chemical equilibrium with the oxygen present in the steel at a temperature slightly above the temperature of solidification may cause the formation of gas holes in the weld metal of electric arc welded steel.

Detecting Defects in Heavy Castings by the Gamma Ray.

The Naval Research Laboratory in the United States has been engaged recently in developing the use for photographic purposes of the gamma ray, emitted by radio-active material. The purpose of this kind of photography is to disclose and record on a plate or film the internal structure of opaque substances, such as metal castings. If internal defects are present they appear on the plate, and their size and position permit an estimate to be made as to whether the strength of the casting is seriously weakened thereby. This useful information could otherwise be obtained only by testing the casting up to the breaking point in a test machine or by trying it in service, neither of which is entirely satisfactory.

The X-ray has been used to investigate the interior structure of metals. The necessary equipment is comparatively inexpensive; competent operators may be readily trained; it is comparatively safe, and the work is rapidly and satisfactorily done. The limitation of the use of the X-ray lies in the fact that its maximum effective penetration is about three inches of steel. By increasing the time of exposure it will penetrate greater thicknesses, but the resulting photograph will not be such as to permit positive determination of the interior structure of the metal.

It was known that radio-active material emits a ray known as the gamma ray which is similar to light rays or X-rays except that it is much shorter in wave-length than either and therefore more penetrative. But radium is a very expensive and dangerous substance which must be handled with particular precautions, and which is difficult to store and to transport.

It seemed logical, therefore, that the gamma ray could be adapted to photographic work which was beyond the capacity of the X-ray. The difficulties in the development process lay chiefly in the expense, in the danger attached to handling radium, and in finding a satisfactory form in which to keep it. Large specimens to be tested, particularly if part of a structure, could hardly be brought to the laboratory. Hence the radium must be in such a form that it can be safely taken to the specimens. Moreover, for satisfactory photographic work, particularly when considerable penetration is required, a steady source of emanation is necessary, which can be obtained only from the material itself.

The development of this problem was sponsored by the Bureau of Engineering and the Bureau of Construction and Repair. Together they supplied the funds for the purchase of one-half gram of radium. The material was obtained in the form of a salt. It is contained in several small silver cylinders of varying sizes. The purpose was to be able to concentrate the maximum possible intensity in the smallest space. This permits a sort of pin-point photography which covers only a small area at a time but penetrates the maximum thickness. The radiating strength of this one-half gram in concentrated form is equal to that of the gas which would be generated spontaneously by 1¾ grams. Any one of the cylinders or any combination of them may be used, depending on the kind of material to be photographed and its thickness.

The development by the Naval Research Laboratory included determination of the times of exposure necessary to obtain good photographs with various kinds and thicknesses of metal. The quantity of radium to be used under various conditions was also determined and the appearance of various defects on photographic film or plate was studied. Photographs were made of steel castings up to 12 in. in thickness, which appears to be about the limit for satisfactory results.

Frequent use is now being made of the gamma ray in photographing large castings made at the U.S. Navy Yards as well as those furnished by commercial firms under contract. As it requires something like 1,800 years for the radiating strength of radium to decrease by one-half, it can confidently be predicted that the cost of the present supply will be saved many times over during its period of usefulness.

Rotary Furnace Patents.

Judgment was delivered, on December 15, by Mr Justice Luxmoore, in the Chancery Division, in an action by Messrs. Pittevil & Company against Brackelsberg Smelting Processes, Limited. The claim was for an injunction restraining defendant company from threatening legal proceedings against users of "Sesci" rotary furnaces, on the ground that these furnaces were an infringement of one of defendant company's patents. Plaintiffs were the exclusive licensees in this country for the manufacture and sale of "Sesci" furnaces, and they said that threats had been made to Messrs. Sir W. G. Armstrong, Whitworth & Company (Iron-founders), Limited, of Gateshead, and the Wycliffe Foundry Company, Limited, of Lutterworth. They alleged that the Brackelsberg patent in question was invalid because of want of utility and novelty.

His Lordship, in granting the injunction asked for, said that the "Sesci" furnace did not infringe the patent, which he held was valid. The patent was for a process of smelting in a rotary furnace by means of pulverised fuel fed by pressure, without the use of a preliminary chamber, air being supplied under sufficient pressure to blow the ash through the furnace so as to prevent it being deposited in the molten metal. He granted plaintiffs an inquiry as to damage caused by the threats, the costs of which would be reserved. On the issue of validity, the costs would be defendant company's.

Cast-Iron Road at Accrington.—The experimental strip of cast-iron roadway at Accrington, made by the local firm of Messrs. Howard & Bullough, Limited, has now been completed. It forms the central part of a roadway upon which tramlines were formerly laid, and if found to be satisfactory it is quite likely that the Corporation in the next financial year will make provision for paving the full width of the road with these blocks.

A New Jar Rollover Machine.

Messrs. Pneulec, Limited, are now manufacturing a small-size jar rollover moulding machine having a maximum capacity of 750 lbs. and carrying a table plate measuring 20 in. by 36 in. The design follows that which has proved so successful with the bigger machines, and it is claimed this new machine will jar, rollover and draw the pattern in less than one minute. In the sectional drawing of the machine (Fig. 2), which gives an idea of the general arrangement and interior construction, the following are the more important features of design: (A) shows slot arrangement for fastening equipment to the turnover plate; (B) details how the table-plate of the jarring machine has impact over the whole area. There is no contact with the top of the jarring cylinder itself, and there is no localised concentration of impact. The density of jar is thus the same all over the table-plate; (C) shows the guarding arrangement which prevents sand working into the interior; (D) shows the arrangement of the mechanical foundation which absorbs shock without in any way interfering with the density of jar, the shock-absorbing material being enclosed to prevent spread; (E) are bronze-bushed bearings; (F) is the turnover plate levelling device; (G) shows the one-piece heavy alloy steel crankshaft to which the rollover arms are fixed; (H) the close-fitting sheet-steel sandguards; (I) the adjustable packing and gland; (J) the spring suspended automatic air-locked, equalising device; (K) the two guide rods and bearing which prevent any lateral movement of the pattern draw cylinder; (L) the high-speed rollover safety feature, which acts as an automatic slowing-down valve, and prevents the turnover plate smashing on to the stop at the end of the stroke; and (M) shows the air-filtering device on jarring machine.

This rollover is claimed as the fastest power jar rollover built, and a study of the design shows how everything has been worked out for speed and ease in operation. For instance, one rotary valve controls all the operations of jarring, rolling over, raising the pattern, draw cylinder, automatic air-equaliser locking device, the vibrator and slow draw, fast draw, rolling back, etc. On this machine the vibrator works automatically when the slow draw is in operation, and has an automatic starting device which allows the air to build up and ensure a good start and proper working of the vibrator.

There is pressure lubrication to every moving part, with automatic lubrication to the vibrator, jarring-machine cylinder and control valve. The rolling over and pattern draw is oil controlled and therefore smooth and positive in operation. There is an entire absence of jerkiness. The equaliser fitted to the top of pattern-draw cylinder for taking up irregularities on the flask or bottom board is a spring-alignment device with an automatic air lock. This, too, is operated from the rotary valve.

The jarring machine is of the impact type and has a built-in mechanical foundation that is shockless. No special foundations are necessary, as all the machine is above the floor line. In installing, all that is necessary is to set the machine down on a shallow bed of concrete, fill up the oil reservoirs, make one pipe connection and everything is ready for operating. All parts are assembled complete on one sub-base, and there are no extras required. The machine is perfectly guarded to prevent sand and dirt coming into contact with moving parts.

This machine is creating considerable interest in the industry, and a number of installations have already been made. The machine is manufactured complete at Mafeking Road, Smethwick, near Birmingham.

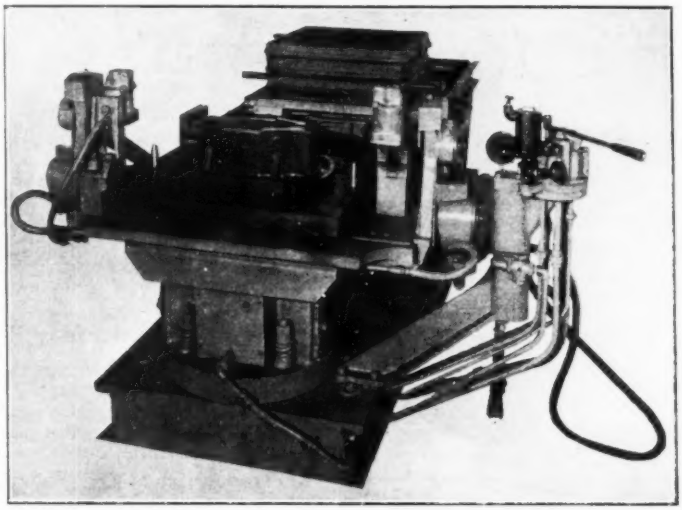


FIG. 1.—A NEW SMALL-SIZED JAR ROLLOVER MACHINE.

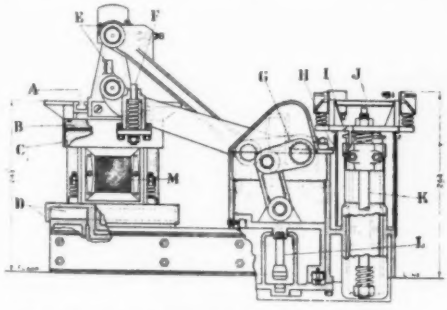


FIG. 2.—CROSS-SECTION OF THE NEW 750-LB. MACHINE.

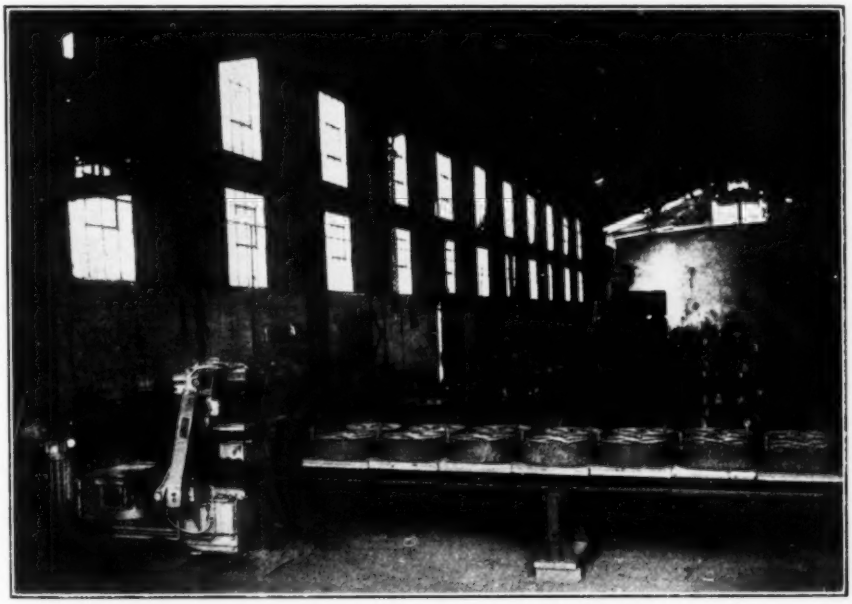


FIG. 3.—AN INSTALLATION IN A DURHAM FOUNDRY.

Publication Received.

The City of Birmingham has sent us a brochure dealing with the potentialities the locality offers for the construction of new works and the conduct of fresh enterprises. It is particularly welcome at the moment when foreigners are exploring the possibilities offered by various centres. This one is specially attractive, as statistics comparing Birmingham's position with other large cities and towns are reproduced. The field surveyed includes canal, rail, road facilities, growth in population, rates, trades and diversity of labour, health, gas and electricity consumption, water, education and prosperity. It is obvious that it is not merely a freak of nature that Birmingham is England's second city, but well-planned enterprise by the municipal authorities.

A Big Casting.—An anvil plate weighing 47 tons was recently cast in the Grimesthorpe Foundry of Cammell's works (English Steel Corporation). It is to form part of a 6,000-ton Davy forging press to be erected at the Stalingrad works of the Russian Government.

This Week's News in Brief.

Trade Talk.

The new tug "Richmond Crawford," built by Lobnitz & Company, Limited, has completed successful trials on the Clyde.

The sum of £149 10s. has been contributed to infirmaries and charitable institutions in the West of Scotland by employees of Babcock & Wilcox, Limited.

Messrs. Swan, Hunter & Wigham Richardson, Limited, Wallsend-on-Tyne, have booked an order for a vessel, about 250 ft. in length, for service on the Canadian Lakes.

The 8,000-ton motor oil tanker "Couch," built and engined by Harland & Wolff, Limited, Govan, for the Anglo-Saxon Petroleum Company, has carried out trials on the Clyde.

Messrs. Vickers-Armstrongs, Limited, Elswick, have received an order from the Great Western Railway Company for five "Norfolk Spades." The object of the appliance is to facilitate the clearance from wagons of small coal.

The Stanton Ironworks Company, Limited, have secured, in face of severe competition from foreign firms, a contract for the delivery of cast-iron pipes to a value of approximately £3,800 to the Municipal Gasworks in Copenhagen.

Messrs. Bruce Peebles & Company, Limited, engineers, Edinburgh, announce that their works will be closed for the New Year holidays from Thursday, December 31, until Wednesday, January 6, inclusive, and their head office on Friday, January 1.

Thos. White & Sons, Limited, Laighpark Engineering Works, Paisley, the well-known manufacturers of machine woodworking tools, have secured an order for the complete equipment of a new cabinet factory for the English Co-operative Wholesale Society, Manchester.

Efforts are being made to get work restarted on the Cunard liner "534," in process of construction on Clydeside. Over 3,000 men ceased work on December 12 at the shipyard of Messrs. John Brown & Company, Limited, as the result of the Cunard Company's decision to suspend the building of the vessel. Many other works throughout the country, including rolling mills, forges and foundries, are affected.

Howden-Ljungstrom Preheaters (Land), Limited, Caxton House, Westminster, London, S.W.1, announce a change of name to James Howden & Company, Limited. The change has been made necessary by the extension of the company's business to include not only the Howden-Ljungstrom air preheater, but also other boiler-house and power-station auxiliaries. The company's policy, personnel and places of business are unaltered.

A factory for building boilers has been set up at Kraljevica, on the Yugoslav coast, by the Adriatic Shipbuilding Company, under an arrangement with Yarrow & Company, Limited, Glasgow. Under the shipping quota law operative in Yugoslavia, a certain proportion of all shipping must be built in the country. The Adriatic Shipbuilding Company, which possesses a floating dock of 2,000 tons capacity, has orders from Yugoslav coastal shipping companies to keep its yards working at full capacity for over four years.

Personal.

Mr. A. Frank Mason, commercial manager and secretary of the Barrow Hematite Steel Company, Limited, has resigned owing to ill-health. Mr. Mason has been in active management for upwards of 20 years. While relinquishing his present duties, the board has retained his services in a consultative capacity. Mr. F. Paul List, who for several years has been general works manager, also retires at the end of the year. To fill the vacancies, Mr. John Davison, joint commercial manager and secretary of the company in London, has been appointed general manager, and Mr. Richard Spencer, of Messrs. Dorman, Long & Company, Limited, Middlesbrough, has been appointed steelworks manager. Mr. W. Killingbeck, chief accountant of the Barrow Company, succeeds to the office of secretary and assistant to the general manager.

Reports and Dividends.

Kendall & Gent (1920), Limited.—Trading profit of £3,630.

Redpath, Brown & Company, Limited.—Profit, £32,896; dividend of 6 per cent., tax free, on the ordinary shares; carried forward, £47,839.

Shotts Iron Company, Limited.—Credit balance, £18,010; brought in, £36,394; depreciation, £25,000; carried forward, after meeting preference dividends, £24,300.

Cargo Fleet Iron Company, Limited.—Profit, £85,666; brought in, £186,430; debenture interest, £36,493; depreciation, £45,000; carried forward, £187,903.

North Lonsdale Iron & Steel Company, Limited.—Credit balance, £4,192, after writing off £1,055 for depreciation of plant; brought in, £19,777; carried forward, £23,969.

Cleveland Bridge & Engineering Company, Limited.—Available, £24,370; final dividend of 3½ per cent., tax free, on the ordinary shares, making 6 per cent., tax free, for the year; to reserve, £5,000; carried forward, £8,246.

South Durham Steel & Iron Company, Limited.—Net profit, after charging £30,000 for depreciation, £35,068; brought in, £138,893; preference dividend, £18,000; dividend of 4 per cent. on the ordinary shares, £14,000; carried forward, £141,961.

Crompton Parkinson, Limited.—Net profit for 15 months ended September 30, £100,021; brought in, £60,708; final dividend of 18¾ per cent. on the ordinary and "A" ordinary shares, making 30 per cent. for the period; to general reserve, £15,000; carried forward, £57,943.

Contracts Open.

Brighstone, Isle of Wight, December 28.—Supply and laying of 1,475 yds. of 6-in. dia. spun-iron water main, and fittings, for the Isle of Wight Rural District Council. Mr. W. E. Blizard, Castle Lane, Southampton. (Fee £2 2s., returnable.)

Congleton, January 4.—2,000 tons of cast-iron pipes and specials, below 9 in. in diameter, for the Congleton Rural District Council. Mr. H. Ferrand, clerk, Crewe Road, Sandbach, Ches. (Fee £2, returnable.)

London, W., January 5.—Iron and steel stores, for the Great Western Railway. The Stores Superintendent, Swindon.

New Delhi, India, January 5.—Transformers and switchgear, for the Indian Stores Department. The Department of Overseas Trade. (Reference A.X. 11,217.)

Northwood, Isle of Wight, December 28.—Supply and laying of 1½ miles of 3-in. dia. cast-iron water main, for the Isle of Wight Rural District Council. Mr. W. E. Blizard, Castle Lane, Southampton. (Fee £2 2s., returnable.)

Stockport, December 31.—6,250 tons of cast-iron pipes and specials, 4 in. to 30 in. dia., and steel flanged pipes, 12 in. and 15 in. dia., for the Corporation. Messrs. G. H. Hill & Sons, 40, Kennedy Street, Manchester. (Fee £3 3s., returnable.)

New Companies.

Radbryt, Limited.—Capital £700. Founders. Directors: E. Carter, 36, Hanover Street, Portsmouth; S. P. Rose.

Abbey Wood Foundry, Limited, Harrow Manorway, Abbey Wood, London, S.E.—Capital £1,000. Directors: C. H. Murrell and J. E. Chell.

Consett Marketing Company, Limited.—Capital £1,000 in £1 shares. Directors: C. D. Smith, Sir James B. Dale, Bt., G. B. Bainbridge, C. A. Cochrane, C. Cookson, E. J. George, J. E. Cowen and R. Alsop (Secretary, Consett Iron Company, Limited, Consett).

The business, including the goodwill, of Messrs. Bernard Holland & Company, in air compressors, vacuum pumps, Diesel engines and locomotives, has been purchased and henceforth will be carried on by the B. A. Holland Engineering Company, Limited, 18, Victoria Street, London, S.W.1.

Notes from I.B.F. Branches.

Burnley Section.—Mr. J. Masters was the lecturer at the last meeting of the Section, held at the local Municipal Technical College. Mr. Alec Jackson presided over a good attendance. The subject dealt with was "Modern Foundry Practice and Developments," and covered such questions as new types of melting plants for both ferrous and non-ferrous materials; continuous core stoves, including the new vertical type; and modern methods of manufacturing automobile-engine castings, such as composite motor pistons. The lecture was well illustrated by numerous lantern slides. The discussion, which was opened by Mr. Roy Stubbs, the Lancashire Branch President, was participated by most of the audience.

Sheffield. — On December 11 the debating society attached to the Sheffield Branch of the Institute of British Foundrymen held a debate, the subject being "Is Foundry Apprenticeship Worth While?" In the absence of the Branch-President the chair was taken by Mr. T. R. Walker, the Branch secretary. Mr. J. Roxburgh opened the debate, and Mr. J. E. Hurst led the opposition.

Mr. Roxburgh maintained that the foundry required a high standard of craftsmanship in its workers and that the work was attractive as it appealed to the individual's pride in the creation of an article. On the monetary side, there were plenty of lucrative positions open to those who fitted themselves for such positions. The foundry industry was making progress, as was instanced by the investigation of alloy cast irons, research on moulding sands and other activities. The schemes recently launched for certificates in foundry practice showed that facilities were available for boys to learn all about their work. Though many foundries were devoted to repetition work, skilled men would always be required for jobbing work.

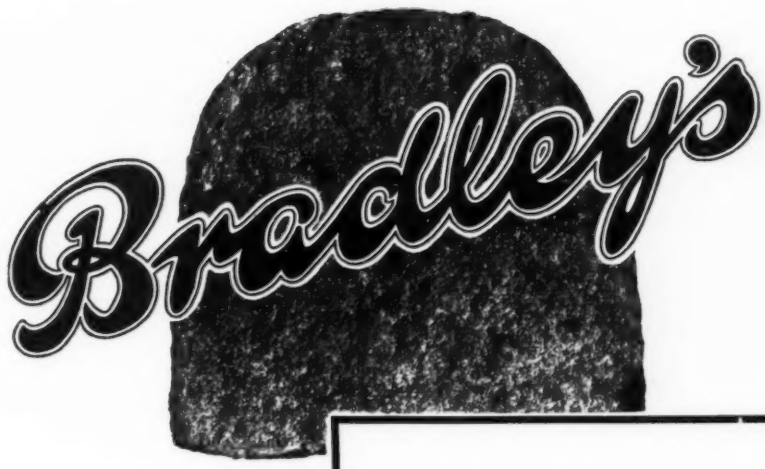
Mr. Hurst urged that there was a great difference between real apprenticeship and the training which nowadays was all the apprenticeship a youth received. The foundry trade was being mechanised and individual skill was being replaced in the foundry by machinery. Apart from machine moulding of complete moulds, foundry work was frequently nowadays merely the assembling of numbered parts. The manufacture of even heavy castings was also largely mechanised. The indenturing of an apprentice would not, under present conditions, be advantageous to a boy in view of the limited experience he would gain. If foundry apprenticeship was worth while the Trade Unions would have insisted on proper schemes of training.

The discussion which followed was very spirited. Mr. B. Winterton inquired for whom this apprenticeship was supposed to be worth while. It was certainly worth while from a firm's point of view, since in the case of a premium apprentice the firm received the premium, and in any case secured cheap labour, apprentices in their later years being given jobs for which the firm would otherwise have to pay a fully-rated man.

Mr. A. Whiteley thought that a keen boy could obtain all the information and training he needed without being apprenticed, and that conditions of employment were very much better now than in the past, when indentured apprentices were very strictly controlled.

Mr. F. E. Steele considered the really important question to be "Is the boy interested in his job?" If not, no system of apprenticeship would greatly benefit him. The early training of a boy, before the age of apprenticeship, was most important. A boy dependent on his job for his livelihood was more likely to benefit from his apprenticeship than a boy from a well-to-do family who knew that he could always change his vocation.

(*Concluded on page* 402.)



take this opportunity of wishing all friends in the trade the Compliments of the Season.

To our Customers we extend our thanks for their support during the past year, and we hope that 1932 will be a Happy and Prosperous one for you all.

DARLASTON

CHRISTMAS 1931

BRADLEY & FOSTER LTD., DARLASTON, STAFFS.

Raw Material Markets.

Quiet conditions are reported from all quarters this week. Apart from the seasonal slackness of trade, the outlook for the beginning of the New Year remains unpromising. Pig-iron consumers are hesitating to enter into new contracts, in view of the uncertain prospects. The light-castings trade is the only one to maintain an appearance of steadiness.

Pig-Iron.

MIDDLESBROUGH.—There is little business passing at the moment, consumers having suspended deliveries for the Christmas holiday and the New Year's stocktaking. A more disturbing feature of the market is the lack of forward contracts, for January and onwards. The export trade is also slow. It was stated at the recent meeting of Messrs. Dorman, Long & Company, Limited, that two blast furnaces at the Cleveland works are to be restarted shortly, subject, of course, to favourable conditions. Prices remain unaltered as follow:—No. 3 Cleveland G.M.B., 58s. 6d.; No. 1 foundry, 61s.; No. 4 foundry, 57s. 6d.; No. 4 forge iron, 57s. per ton.

Business is disappointing in the East Coast hematite market, and few new orders are forthcoming. Sheffield consumers, in particular, are finding trade bad. The quotation for mixed numbers remains at 65s., a shilling more having been paid for named brands. On the North-West Coast, stocks of hematite are tending to accumulate.

LANCASHIRE.—There is a falling-off in deliveries to the foundries, and the outlook for January is not encouraging. Fears are expressed that the proposals of the cotton-trade organisations to secure control of surplus weaving machinery will swell the supplies of scrap iron, and also add to the difficulties of the textile-machinery foundries. Prices are maintained, with Midland foundry makes on offer for delivery to users in the Manchester price zone at 67s. per ton, North-East Coast at 67s., Northamptonshire at 65s. 6d., Derbyshire forge iron at 62s., Scottish pig-iron at about 87s. and West Coast hematite at about 81s.

MIDLANDS.—Consumers have, in many cases, covered their requirements for some months ahead, and the market shows a weaker tendency. The heavy engineering trades are still in a depressed condition. For delivery to Birmingham and Black Country stations, makers still quote 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—The Scottish pig-iron market remains quiet, only a few small sales for immediate delivery being reported. Continental iron is virtually out of the market, being now dearer than the home product. Scottish No. 3 foundry iron continues at 69s. 6d. f.o.t. furnaces, with 2s. 6d. extra for No. 1. Cleveland No. 3 is at 61s. 6d. at Grangemouth.

Coke.

The market for cupola coke in the Midlands remains steady, best grades being 37s. 6d. to 39s., with cheaper qualities at 35s. per ton. The market for Welsh coke fluctuates considerably, present prices ranging from 30s. to 47s. 6d. per ton. The price of Middlesbrough furnace coke is 16s. 6d. per ton delivered works in that area.

Steel.

The position of the finished steel market is unsatisfactory, the works being badly in need of orders. The shipbuilding and heavy engineering industries continue in a depressed state. Prompt sellers of Continental semis have reported several orders, but the general demand for semi-finished steel is not very large.

Scrap.

Both consumers and merchants in the Cleveland scrap iron and steel market are content to pursue a waiting policy until the New Year. Heavy steel scrap is strong at 42s. 6d., with machinery quality at 47s. 6d. There is a good market for cast-iron scrap in the Midlands, and machinery quality is quoted at 52s. 6d. per ton, with light cast iron at 40s. per ton, delivered. The South Wales market remains quiet. In Scotland, business has tapered off, but prices are maintained at former levels.

Metals.

Copper.—The sharp rise in the price of copper that occurred at the end of last week was due, firstly, to a fall in sterling, and, secondly, to the report that the Phelps Dodge Corporation, ranking third largest in the list of American producers, had cancelled its withdrawal from the Exporters' Association. The latter's quotation, c.i.f. Europe, has now been raised to 7.50 cents. It is stated that a complete scheme for reductions in output has been definitely agreed to by the producers. Domestic buying in the United States remains on a poor scale, but there has been a better demand from consumers in Europe.

Closing quotations :—

Cash.—Wednesday, £37 17s. 6d. to £37 18s. 9d.; Thursday, £38 18s. 9d. to £39 1s. 3d.; Friday, £41 2s. 6d. to £41 3s. 9d.; Monday, £40 2s. 6d. to £40 5s.; Tuesday, £40 8s. 9d. to £40 11s. 3d.

Three Months.—Wednesday, £38 8s. 9d. to £38 10s.; Thursday, £39 11s. 3d. to £39 13s. 9d.; Friday, £41 15s. to £41 17s. 6d.; Monday, £40 15s. to £40 17s. 6d.; Tuesday, £41 2s. 6d. to £41 5s.

Tin.—It is announced that the stocks held by the International Tin Pool, which now amount to some 19,000 tons, will only be released in accordance with the new agreement. The former minimum price of £150 a ton has been increased to £165, which will be the level at which 5 per cent. of the pool's holding may be released. The next price limit, at which 10 per cent. may be released, has been similarly increased to £176. Sales in Europe last week were on a fairly good scale, but buying on the other side of the Atlantic remains unsatisfactory.

Official closing prices :—

Cash.—Wednesday, £138 2s. 6d. to £138 5s.; Thursday, £138 10s. to £138 12s. 6d.; Friday, £138 17s. 6d. to £139 2s. 6d.; Monday, £141 to £141 2s. 6d.; Tuesday, £141 17s. 6d. to £142.

Three Months.—Wednesday, £141 2s. 6d. to £141 5s.; Thursday, £141 7s. 6d. to £141 10s.; Friday, £142 to £142 5s.; Monday, £144 to £144 2s. 6d.; Tuesday, £144 17s. 6d. to £145.

Spelter.—There has been little business passing with consumers in this country, the galvanising industry, in particular, being in a depressed state. It is hoped that demand may improve with the turning of the year.

Daily fluctuations :—

Ordinary.—Wednesday, £14 2s. 6d.; Thursday, £14 6s. 3d.; Friday, £14 8s. 9d.; Monday, £14 15s.; Tuesday, £14 15s.

Lead.—The price of this metal has remained steady, although demand is quiet, the chief sales last week being to cable-makers, who had been off the market for some time. Consumption in the United States shows no improvement.

The week's prices have been :—

Soft Foreign (Prompt).—Wednesday, £14 17s. 6d.; Thursday, £15; Friday, £15; Monday, £15 6s. 3d.; Tuesday, £15 7s. 6d.

Castor oil is a good lubricant to use when tapping fine threads.

Mandrels for white metalling bearings should be slightly tapered to ease removal.

Experiments have proved that metals may be hardened by means of rotating magnetic fields. The metals which have been treated include high-speed and high-carbon steel, mild steel, brass and duralumin. In all cases a greater hardness resulted. The results seem partly dependent on the temperature; with hard steel better results were obtained at 100 deg. C. than at room temperature.

Notes from I.B.F. Branches.

(*Concluded from page* 400.)

Mr. A. E. Scrayfield thought that for most jobs in a modern foundry a great deal of skill was not required, and what was necessary could be picked up by the boys between the ages of 16 and 19, without any definite apprenticeship being involved. After further discussion, Mr. Roxburgh and Mr. Hurst made brief final speeches.

The Chairman, in summing up, pointed out that from a monetary point of view a moulder was usually rather higher than other skilled artisans. The educational scheme for foundry certificates were no doubt desirable, but in Sheffield, at any rate, it was difficult to get apprentices to join the classes, the members of the classes being mainly older workers. Classes to supplement the practical work of the younger apprentices should be given by the firm during working hours, so that attendance was compulsory. Firms in America having efficient schemes of apprentice training found that though they lost some of the workers they had trained, they gained about the same number from other firms. An apprentice who had had a proper training in different parts of the foundry would have more pride in himself, be more useful to his firm, and be more likely to find other employment if it became necessary, than one lacking such training.

The result of the voting was a tie, and the chairman's casting vote was given in favour of the motion that foundry apprenticeship is worth while. The meeting concluded with a vote of thanks to the principal speakers and the Chairman, proposed by Mr. W. A. Macdonald and seconded by Mr. A. Whiteley.

West Riding of Yorkshire Branch.—The council has definitely arranged for the first dinner of the Branch to be held on January 9, at the County Restaurant, Bradford, commencing at 6.30. Members are specially requested to bring their ladies, and an excellent concert party has been engaged. The price of the tickets has been fixed at 7s. 6d. to bring the dinner within the reach of all members, and as the accommodation is limited to 70, members would be well advised to make early application.

Permanent Moulds.

For the production of iron castings in permanent moulds made of metal, several alloys have been tried. The most satisfactory metal has been found to be cast iron, of approximately the same composition as the iron being cast. Before pouring the metal the surfaces of the mould should be given a coating of smoke from an oxyacetylene torch; this should be done before each pouring, even with mould in constant use.

Acetylene smoke has been found the most effective, as it will penetrate into otherwise inaccessible positions. The advantages of permanent moulds are that the castings produced are more uniform in dimensions and hardness. The process also saves in foundry space.

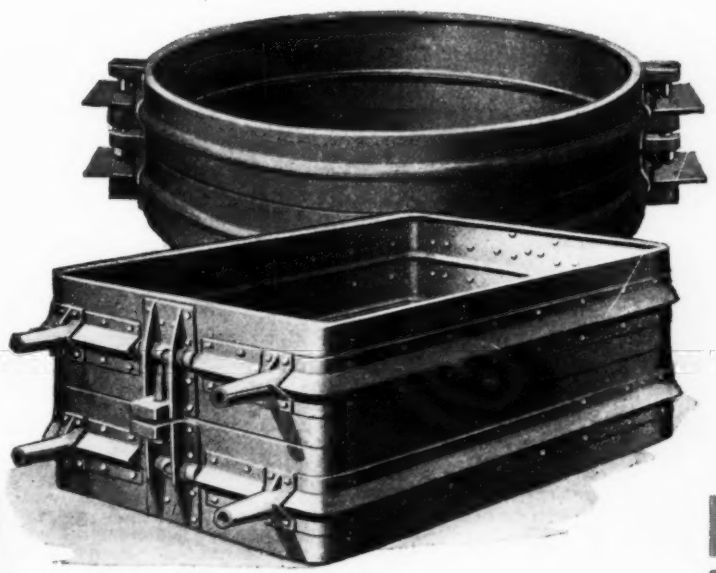
Whitehead Iron & Steel Company, Limited.—The directors report that the trading profit for the half-year to September 30 maintains approximately the same level as the preceding half-year. This is considered satisfactory, having regard, firstly, to the abnormally difficult trading conditions of the last quarter, and, secondly, to the period being a transitionary one in which the company's business was being entirely reorganised. This reorganisation is now completed; a new semi-continuous mill has been put into successful operation; the Tredegar Works have been closed; and the whole of the company's production and offices have been centralised at the Newport Works. This has effected a substantial reduction in costs, but, having regard to the continued uncertainty in the industrial outlook, the directors consider the proper course is to conserve the company's resources and defer consideration of a dividend.

Service Sterling

SOLID RIBBED ROLLED STEEL

MOULDING BOXES

To give you the advantages of both price and quality that result from standardised production, Sterling boxes are made in thirty standard designs. Notwithstanding this, our technical staff are constantly engaged in designing boxes for special purposes, embodying those important Sterling features — Lightness, Strength, Rigidity and Accuracy. Thus the final product of England's largest Foundry Equipment Works offer the nearest approach to perfection that technical skill can economically provide.



STERLING FOUNDRY SPECIALTIES LIMITED. BEDFORD

London Office:— 13, Victoria Street, S.W.1.

Agents at:— MANCHESTER. GLASGOW. NEWCASTLE-ON-TYNE.

TELEGRAMS: "STERFLASK, BEDFORD" TELEPHONE: 3345 BEDFORD.

CODE: WESTERN UNION

WEEKLY PRICE CURRENT.

[December 22, 1931.]

COPPER.

	£	s.	d.
Standard cash	40	8	9
Three months	41	2	6
Electrolytic	47	0	0
Tough	41	5	0
Best selected	41	10	0
Sheets	77	0	0
India	58	10	0
Wire bars	49	15	0
Do., January	49	15	0
Do., February	49	15	0
Ingot bars	49	15	0
H.C. wire rods	47	0	0
Off. av. cash, Nov.	35	18	1½
Do., 3 mths., Nov.	36	9	10 3/16
Do., Sttlmnt., Nov.	35	17	11 5/8
Do., Electro, Nov.	42	1	2⅜
Do., B.S., Nov.	38	3	1½
Do., wire bars, Nov.	42	18	6⅜
Solid drawn tubes			11d.
Brazed tubes			11d.
Wire			7½d.

BRASS.

Solid drawn tubes	10d.
Brazed tubes	12d.
Rods, drawn	8⅞d.
Rods, extd. or rlld.	5½d.
Sheets to 10 w.g.	8½d.
Wire	8⅜d.
Rolled metal	7⅞d.
Yellow metal rods	5½d.
Do. 4 × 4 Squares	6½d.
Do. 4 × 3 Sheets	6½d.

TIN.

	£	s.	d.
Standard cash	141	17	6
Three months	144	17	6
English	143	5	0
Bars	144	10	0
Straits	143	12	6
Australian	143	2	6
Eastern	143	5	0
Banca (nom.)	157	17	6
Off. av. cash, Nov.	132	18	10⅜
Do., 3 mths., Nov.	135	2	6
Do., Sttlmt., Nov.	132	17	10⅜

SPELTER.

	£	s.	d.
Ordinary	14	15	0
Remelted	13	15	0
Hard	11	15	0
Electro 99.9	17	0	0
English	15	12	6
India	14	0	0
Zinc dust	23	0	0
Zinc ashes	4	0	0
Off. aver., Nov.	14	0	10 5/16
Aver. spot, Nov.	13	16	10⅜

LEAD.

	£	s.	d.
Soft foreign ppt.	15	7	6
English	16	15	0
Off. average, Nov.	14	10	8 3/16
Average spot, Nov.	14	11	6⅜

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex-whf.	27	10	0
Rods	32	0	0
Boiler plates			—
Battery plates			—

ANTIMONY.

	£	s.	d.
Special brand, Eng.	40	0	0
Chinese	28	10	0
Crude	22	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver (nom.)	19	17	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£6 17 6
45/50%	£9 5 0
75%	£15 5 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free, nominal.	
Ferro-titanium—	
23/25% carbon-free	11½d. lb.
Ferro-phosphorus, 20/25%	£16 17 6
Ferro-tungsten—	
80/85%	1/8½ lb. plus 20%
Tungsten metal powder—	
98/99%	1/11½ lb. plus 20%
Ferro-chrome—	
2/4% car.	£34 10 0
4/6% car.	£23 15 0
6/8% car.	£22 5 0
8/10% car.	£21 12 6
Ferro-chrome—	
Max. 2% car.	£36 5 0
Max. 1% car.	£41 17 6
Max. 0·70% car.	£52 0 0
70%, carbon-free	11½d. lb.
Nickel—99% (nom.)	£245 to £250
Ferro-cobalt	10/3 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	3/- lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £ 9 0 0
Metallic manganese—	
94/96% carbon-free	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel					2	7	6
Bundled steel and shrngs.	1	15	0	to	2	6	6
Mixed iron and steel	2	2	0	to	2	3	6
Heavy cast iron	2	7	6	to	2	8	0
Good machinery for foundries	2	12	6	to	2	15	0
Cleveland—							
Heavy steel					2	2	6
Steel turnings					1	12	6
Cast-iron borings					1	6	0
Heavy forge					3	2	6
W.I. piling scrap					2	15	0
Cast-iron scrap	2	5	6	to	2	7	6
Midlands—							
Light cast-iron scrap					2	0	0
Heavy wrought					2	15	0
Steel turnings, f.o.r.					1	2	6
Scotland—							
Heavy steel					2	2	6
Ordinary cast iron					2	8	0
Engineers' turnings					1	10	0
Cast-iron borings					1	12	6
Wrought-iron piling					2	7	6
Heavy machinery					2	15	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	32	0	0
Brass	24	0	0
Lead (less usual draft)	12	10	0
Tea lead	9	10	0
Zinc	7	15	0
New aluminium cuttings	62	0	0
Braziery copper	30	0	0
Gunmetal	28	0	0
Hollow pewter	90	0	0
Shaped black pewter	70	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	65/6
Hematite M/Nos.	65/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	73/-
,, d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
,, No. 4 forge*	61/-
,, No. 3 fdry.*	66/-
Shrops basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	57/6
,, fdry. No. 3*	62/6
,, fdry. No. 1*	65/6
Derbyshire forge*	61/-
,, fdry. No. 3*	66/-
,, fdry. No. 1*	69/-
,, basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
,, No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
,, fdry. No. 3	63/6
Lincs forge	—
,, fdry. No. 3	63/6
E.C. hematite	76/-
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
,, fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	87/-
Clyde, No. 3	87/-
Monkland, No. 3	87/-
Summerlee, No. 3	87/-
Eglinton, No. 3	87/-
Gartsherrie, No. 3	87/-
Shotts, No. 3	87/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.		£	s.	d.
Iron—							
Bars (cr.)	9	15	0	to	10	5	0
Nut and bolt iron	8	7	6	to	8	12	6
Hoops	10	10	0	to	12	0	0
Marked bars (Staffs) f.o.t.					12	0	0
Gas strip	10	10	0	to	12	0	0
Bolts and nuts, ¾ in. × 4 in.					12	10	0
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	8	17	6	to	9	15	0
Chequer plts.					10	7	6
Angles					8	7	6
Tees					9	7	6
Joists					8	15	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ¾ in. (Untested)			6	15	0	& up.	
Flats—8 in. wide and over					8	12	6
,, under 8 in. and over 5 in.					8	17	6
Rails, heavy	8	5	0	to	8	10	0
Fishplates					12	0	0
Hoops (Staffs)					9	10	0
Black sheets, 24g.	8	0	0	to	9	0	0
Galv. cor. shts.	9	0	0	to	9	5	0
Galv. flat sheets	9	10	0	to	9	15	0
Galv. fencing wire, 8g. plain						—	
Billets, soft	5	7	6	to	5	12	6
Billets, hard					6	12	6
Sheet bars	5	0	0	to	5	10	0
Tin bars					5	0	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11⅜d.
Sheet to 10 w.g.	12⅜d.
Wire	12⅜d.
Rods	11⅛d.
Tubes	17d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	15.51
No. 2 foundry, Valley	16.00
No. 2 foundry, Birm.	12.00
Basic	16.76
Bessemer	18.26
Malleable	18.26
Grey forge	17.76
Ferro-mang. 80%	75.00
O.-h. rails, h'y, at mill	43.00
Billets	29.00
Sheet bars	29.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.55
Beams, etc.	1.50
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.80
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	2.90
Wire nails	1.90
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	22/- to 25/-
,, furnace	16/6 to 17/6
Durham and Northumberland—	
,, foundry	15/- to 15/6
,, furnace	14/-
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box 14/- to 14/6
,,	28×20 ,, 28/- to 29/-
,,	20×10 ,, —
,,	18¾×14 ,, —
C.W.	20×14 ,, 13/-
,,	28×20 ,, 25/3
,,	20×10 ,, 19/4½
,,	18¾×14 ,, 13/9

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	0	0
Bars, hammered, basis	£16	10	0	to	£17	0	0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	5	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£18	0	0	to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0	to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	62½%	57½%
Water ..	58½%	52½%
Steam ..	55%	47½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Dec.	16 ..	37	17	6	inc.	16/3
,,	17 ..	38	18	9	,,	21/3
,,	18 ..	41	2	6	,,	43/9
,,	21 ..	40	2	6	dec.	20/–
,,	22 ..	40	8	9	inc.	6/3

Electrolytic Copper.

		£	s.	d.		
Dec.	16 ..	43	0	0	No change	
,,	17 ..	43	10	0	inc.	10/–
,,	18 ..	47	10	0	,,	80/–
,,	21 ..	47	0	0	dec.	10/–
,,	22 ..	47	0	0	No change	

Standard Tin (cash).

		£	s.	d.		
Dec.	16 ..	138	2	6	inc.	35/–
,,	17 ..	138	10	0	,,	7/6
,,	18 ..	138	17	6	,,	7/6
,,	21 ..	141	0	0	,,	22/6
,,	22 ..	141	17	6	,,	17/6

Tin (English ingots).

		£	s.	d.		
Dec.	16 ..	139	15	0	inc.	30/–
,,	17 ..	140	0	0	,,	5/–
,,	18 ..	140	10	0	,,	10/–
,,	21 ..	142	10	0	,,	40/–
,,	22 ..	143	5	0	,,	15/–

Zinc Sheets (English).

		£	s.	d.		
Dec.	16 ..	24	10	0	No change	
,,	17 ..	24	10	0	,,	,,
,,	18 ..	24	10	0	,,	,,
,,	21 ..	24	10	0	,,	,,
,,	22 ..	24	10	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
Dec.	16 ..	14	2	6	inc.	2/6
,,	17 ..	14	6	3	,,	3/6
,,	18 ..	14	8	9	,,	2/6
,,	21 ..	14	15	0	,,	6/3
,,	22 ..	14	15	0	No change	

Lead (English).

		£	s.	d.		
Dec.	16 ..	16	5	0	No change	
,,	17 ..	16	10	0	inc.	5/–
,,	18 ..	16	10	0	No change	
,,	21 ..	16	15	0	inc.	5/–
,,	22 ..	16	15	0	No change	

AVERAGE MONTHLY PRICES OF WEST COAST HEMATITE MIXED NUMBERS DELIVERED SHEFFIELD.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1892	47 4	45 6	46 4½	47 8	49 5	50 4½	49 7½	49 10½	49 10½	48 8½	46 10	46 1½	48 2½
1893	46 0½	45 8	45 11	45 7	44 11	44 9½	44 10	45 3	45 0	44 6	44 7	45 8	45 3
1894	45 3	45 3	45 1½	45 1	43 11	43 11	43 9½	44 2	44 7½	43 7	43 5	43 3	44 3½
1895	42 8	42 5½	42 6	42 10	43 10	43 7½	44 10	45 11	49 11	48 9	47 7½	47 7½	45 2½
1896	47 0	48 9	48 9	48 2½	47 3	47 3	46 10	46 10	47 2	48 5	50 7	50 6	48 1½
1897	51 2	49 10	48 5	47 4	47 9½	48 6	47 0	47 3	47 3	47 0	48 3½	47 11	48 2
1898	48 9	48 10	49 4	49 8½	50 10	50 3½	51 0	52 5	53 11	55 8	57 3	56 10	52 1½
1899	59 1	59 9	57 7	59 6	64 7	70 10½	76 7½	72 2	74 3	75 0	78 1½	73 3	68 5
1900	75 3½	76 10	79 10	84 6	81 4	79 1½	83 4	81 5	79 11	76 10	77 8½	68 4	78 8
1901	60 2	59 0	57 9½	57 6½	57 8	57 4½	57 8	61 0	60 0½	59 9	58 7½	56 7	58 7½
1902	56 1	57 9½	59 3½	59 9	59 10½	60 0	60 0	60 8½	61 5	61 2	59 3	59 0	59 6
1903	58 5	58 8	61 1	59 5	57 10	57 3	56 7	56 3	55 9	54 8	52 4	52 4	56 8½
1904	52 8½	53 1	53 7	54 9	54 2	53 2½	52 9	52 5	52 2½	52 7	53 1	55 11½	53 5½
1905	57 9½	56 9	58 1	58 2	56 4	55 8	55 5½	56 7	61 0	68 9	69 9	70 11½	60 5½
1906	70 4½	65 2½	63 4½	63 9	64 5	64 6	64 1	66 2½	67 3	69 4½	72 4½	78 8½	67 5
1907	77 9	72 11	71 10	73 9	79 9½	76 9	77 9	78 4	75 11	72 9½	68 6	66 7	74 4
1908	62 7	59 1	61 6½	61 6½	61 4	59 1	57 9½	56 11	60 2	59 2	58 5½	57 7	59 7½
1909	51 4	56 5	55 3	56 1	56 4	57 0	56 8	58 0	61 0	61 1½	60 7½	61 4	58 1½
1910	64 0½	64 3½	66 10½	67 6½	66 2½	65 4	64 4½	65 6½	65 2	64 10½	64 6	65 6	65 4½
1911	66 9	66 1	64 10	63 1	62 1	62 0	61 2	62 2	62 1	61 1	61 10	64 0	63 1
1912	67 0	67 0	67 0	69 3	71 9½	72 11	75 9½	79 1½	82 2½	85 0	85 3½	86 6	75 9½
1913	86 6	86 6	86 3	85 0	83 6½	80 10½	78 1	76 10½	72 6	71 0	68 0	65 3	78 4½
1914	64 6	65 4½	65 6	64 11½	64 2½	64 0	64 0	68 11½	74 6½	71 0	65 4½	69 9½	66 10½
1915	78 9	100 6	103 1	113 6	111 9	114 0	116 3	115 2½	113 8½	121 1½	131 9½	139 6½	113 3
1916	135 0	135 0	133 4	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	129 2½
1917	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6
1918	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6
1919	127 6	127 6	127 6	127 6	180 6	184 3	195 4½	204 6	204 6	204 6	204 6	204 6	174 7
1920	224 9	235 0	245 0	275 0	290 0	295 0	295 0	295 0	295 0	295 0	295 0	280 0	284 11½
1921	263 4	228 4	180 0	180 0	180 0	160 0	160 0	157 6	142 0	128 6	121 0	115 6	167 9½
1922	125 0	117 6	115 0	115 0	115 0	115 0	113 1½	104 0	105 0	105 0	106 3	110 0	112 1
1923	109 0½	116 5½	133 11½	138 3½	134 2	125 0	115 7½	111 9	110 0	110 0	113 11	115 0	119 5½
1924	115 0	115 0	114 4½	112 6	112 6	112 6	111 0	110 0	110 0	105 4½	102 6	102 6	110 3½
1925	102 6	102 6	100 0	98 6	97 6	95 1½	92 6	90 6	88 3	87 0	88 1½	88 9½	94 3½
1926	90 1½	90 0	89 8½	89 0	89 0	89 0	90 2½	91 9	94 0	97 2½	*	*	91 0
1927	95 4½	95 6	96 6	95 6	95 3	94 0	92 10½	91 6	90 6	90 6	90 6	89 6	93 1½
1928	85 0	85 3	85 5	85 0	85 3	84 9	84 0	83 9	84 0	84 0	83 1	82 6	84 4
1929	82 10½	83 6	85 0	86 9	87 0	87 0	87 3	87 2½	87 6	89 6	89 6	89 10½	86 11
1930	91 6	91 6	91 6	90 0	89 7½	88 0	87 7½	86 6	86 6	86 6	86 6	86 6	88 6½
1931	86 6	84 6	84 6	84 6	84 6	82 6	82 6	81 6	81 6	83 6	83 6	—	—

* No prices available.

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Three Geared Foundry Ladles, with Carriers, each 3 ft. 7 in. dia. at top x 3 ft. bottom x 3 ft. 9½ in. deep.

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12-Ton "Stevenson"	...	£48
9-Ton "MacNeil"	...	£42
6-Ton "Thwaites"	...	£34
4-Ton "Evans"	...	£28
2-Ton "Evans"	...	£19

SAND PLANT

3 ft. 6 in. "Evans" Sandmill		£15
"Jackman" SM4 Aerator	...	£12
"Herbert" sand whizzer	...	£32
"Jackman" Rotary Sifter	...	£8

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PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun, and on occasions—be it admitted—of naughtiness. Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception. Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,

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